No. 334

DIES AND DIE HOLDERS

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MODEL ENGINEERS' WORKSHOP

THE MAGAZINE FOR HOBBY ENGINEERS, MAKERS AND MODELLERS DECEMBER 2023 ISSUE 334 WWW.MODEL-ENGINEER.CO.UK

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INSIDE THIS PACKED ISSUE:

- A REAR TOOLPOST FOR STRESS-FREE PARTING OFF.
- CUTTING SMALL ITEMS ON THE BANDSAW.
- REVIVING A SUPER ADEPT – HOWARD LEWIS BRINGS A 1930'S CLASSIC BACK TO LIFE.
- INDEX – YOUR PULL-OUT GUIDE TO ISSUES 321 TO 332.
- MAKING CHRIS HALLAWAY'S DIVIDING HEAD.
- HOW TO USE AND FIT CIRCLIPS.
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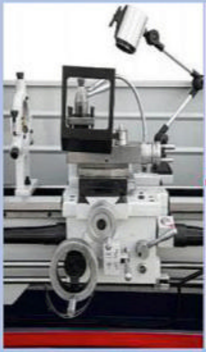

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Manufacturer	Cormak	Manufacturer	Cormak
Model	**Tytan 750 Universal Lathe**	Model	**TORNADO 360 Universal Lathe**
Swing over bed	250mm	maximum turning diameter	360mm
Swing over cross slide	150mm	maximum turning diameter over the bed	220mm
Centre width	750mm	maximum turning diameter in the selected bridge	490mm
Bed width	135mm	maximum rolling length in the choice of the bridge	168mm
Spindle bore	26mm	turning length in fixed fishes	970mm
Spindle tip	MT4	bed width	187mm
Spindle speed (smooth adjustment)	50–2250 rpm	spindle end	D1-4
Metric thread	(18) 0.2–3.5 mm/rev	spindle bore	52mm
Inch thread	(21) 8–56 threads/inch	spindle rotation range	90-2000rpm
Longitudinal feed	0.07 -0.4mm/rev	spindle speed number	8 ranges
Tool holder	4-Way	range of longitudinal feed	0.055 - 1.291 mm / rev
Tool holder Dimensions	12 x 12mm	range of transverse feed	0.014-0.345 mm / rev
Maximum cross support travel	70 mm	the maximum dimension of the tool	16mm x 16mm
Maximum transverse support travel	110 mm	metric thread	0.4-7 mm
Maximum longitudinal support travel	650 mm	inch thread	4-60 TPI
Tailstock Quill Diameter	30 mm	pipe bush diameter	32mm
Tailstock spindle travel	60 mm	sleeve end of the horse	MT3
Tailstock quill taper	MT2	engine power	1.5Kw
Motor power	1.1kW / 230V	pump power	0.1Kw
Dimensions (with base)	1350×560×1250 mm	weight	570kg
Weight	205 kg	dimensions	1890x720x1500 mm

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The next issue will be on sale 15 December 2023.

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On the Editor's Bench

The New Forum

Readers who use the forum at www.model-engineer.co.uk will be aware that the planned changes have run into a whole range of technical issues. The change in the forum was essential due to the very out of date software the old one was running on. Unfortunately, this very issue has meant the changes have taken far more work to address than was expected.

One consequence was the big delay in getting the forum back up; in the end it was decided to go live even though there were many issues still to be sorted, as the delay was becoming just too great.

We continue to see improvements, but there remains a long log of outstanding technical issues that is being worked through as a priority.

There are other issues, many of which have been raised by forum members, particularly around the layout, essentially issues of design rather than fundamentally getting the forum working smoothly.

Staff at Mortons are focusing on making the forum more reliable, faster, stable and free from spam, but please be assured that issues of design and presentation will be looked at. In particular getting the list of 'latest activity' working well is proving challenging as the default method triggers a search and sort of every post on the entire forum, which takes ages and slows everything down. Essentially a new method of indexing latest posts has to be built from scratch.

If you are currently finding the site difficult to use, you may wish to visit less frequently for a week or two while further changes are put in place. It could well be longer before all the significant changes are implemented. Be assured your feedback is noted and issues are being addressed.

Until then, the patience of forum members is greatly appreciated and as is your support for the moderators who have put in a huge amount of effort trying to assist members with problems using the forum.

Neil Wyatt

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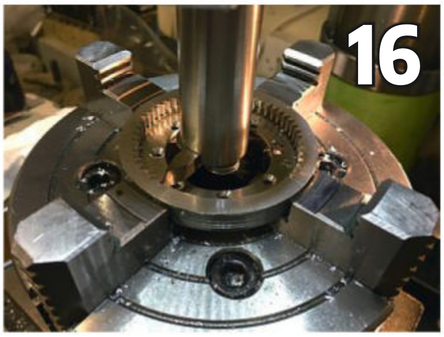

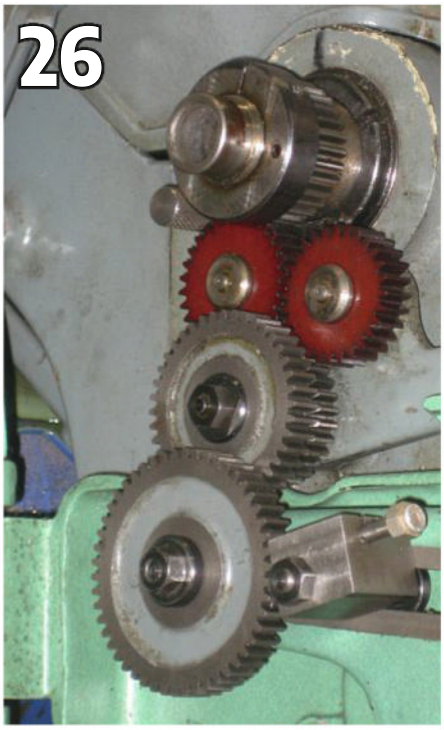

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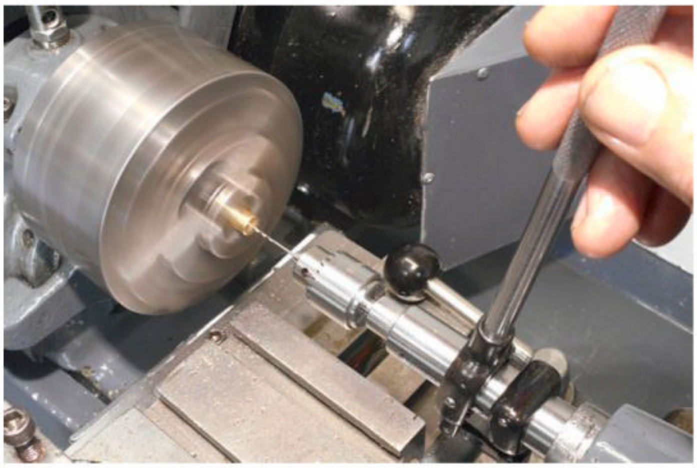
Coming up...

in our next issue

Peter Barker describes a useful device to allow 'sensitive' drilling from the lathe tailstock.



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ON THE COVER

Our cover shows George H. Thomas' Universal Pillar Tool made as originally envisaged. Next year this classic design is fifty years old, see pages 37-14.

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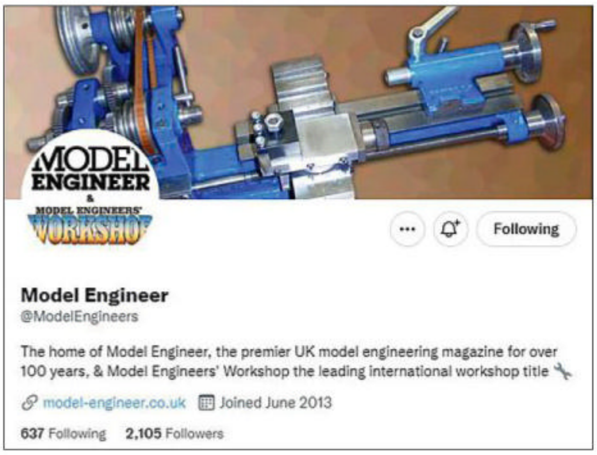

THIS MONTH'S BONUS CONTENT

The Forum is changing!

You can log on to the new forum using your existing details, you can recover your password to the email address associated with your account. There have been issues with getting the forum working smoothly again, but there is help and assistance available if you have any questions or issues getting to know your way around the new forum software. We have also set up 'practice' threads so you can try posting images and documents. www.model-engineer.co.uk

Hot topics on the forum include:

Rubber tyre glue Making solid rubber tyres for a water bowser by Jonathon MC.

Halfords flex head spanners Appreciation of some durable tools by Ady1.

Feeds and speeds for a shell mill I am getting my speeds and feeds right by Paul L.

Cleaning rusty parts Deep cleaning old parts by Anthony Harding.

Come and have a Chat!

As well as plenty of engineering and hobby related discussion, we are happy for forum members to use it to share advice and support. Come and join us – it's free to all readers!

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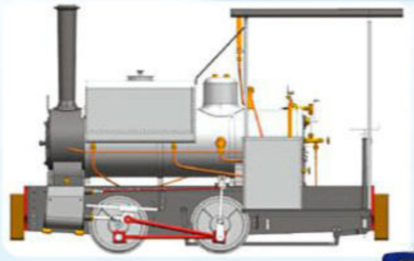

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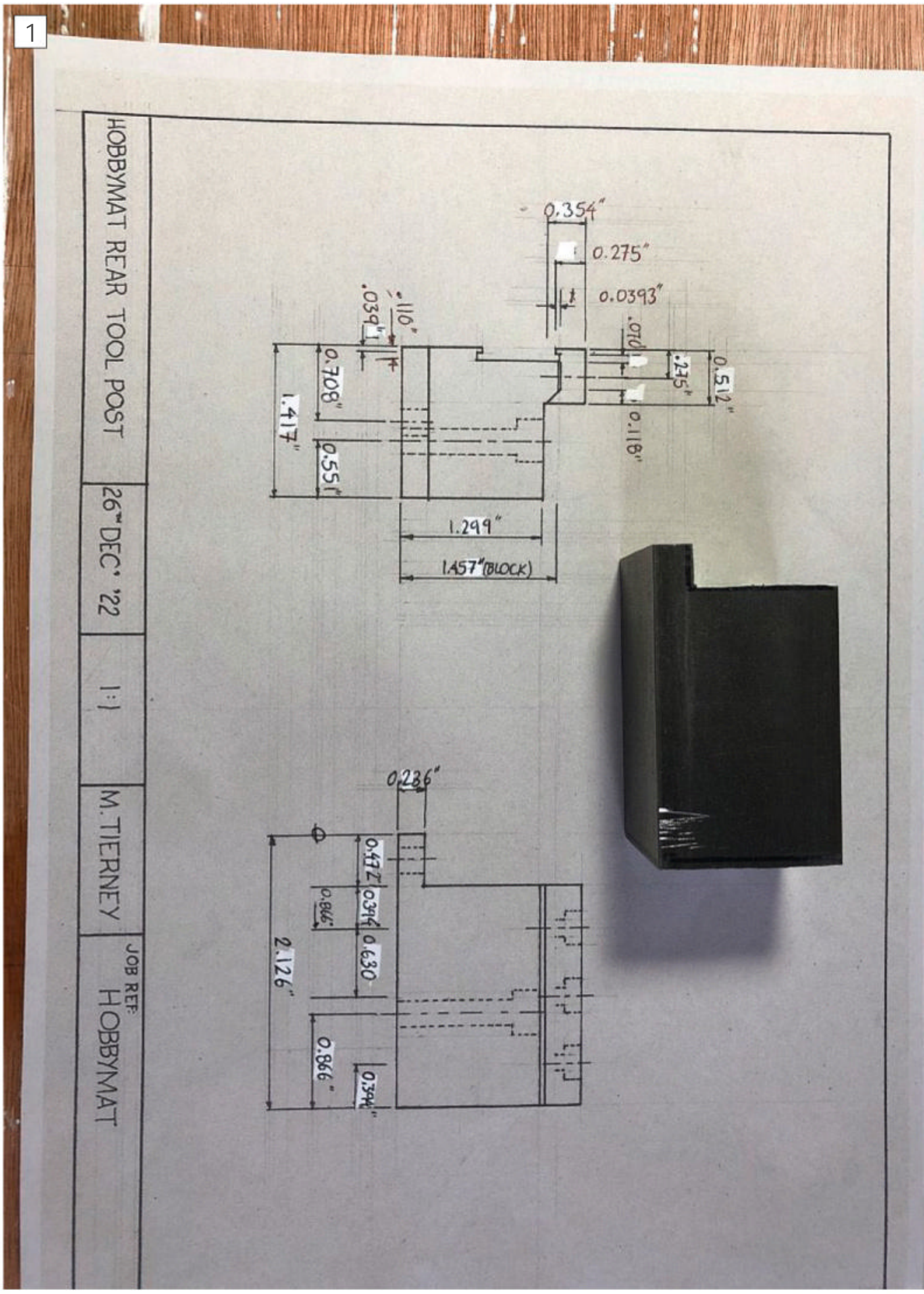
A Rear Toolpost for Parting Off

Malcolm Tierney make a rear-mounted toolpost for his Hobbymat lathe to ensure stress-free parting off.

My Hobbymat is an overworked wee lathe. I am quite happy parting off with high-speed steel however I have had occasions when some stainless has greedily eaten some of my carefully ground tooling. I chose to invest in the RDG Tools TCT parting tool SLTBN10-02. When I purchased my lathe, I also invested in the Essel Engineering four-way toolpost. This accepts 6mm HSS tooling and if one grinds tools on this and leaves the steel at full height it will be pretty much spot on centre. The RDG parting tool holder is oversize and leaves the tool above centre. As this is the smallest size, the holder has to be reduced. I found that the centre of the tool is level with the top of the lug that clamps in the toolpost, so it is necessary to reduce the bottom of the lug until the lug is 6mm thick. I first attempted this in my Dore Westbury mill and ate an HSS endmill. Having then invested in a solid carbide 10mm endmill the RDG toolholder yielded to my intentions.

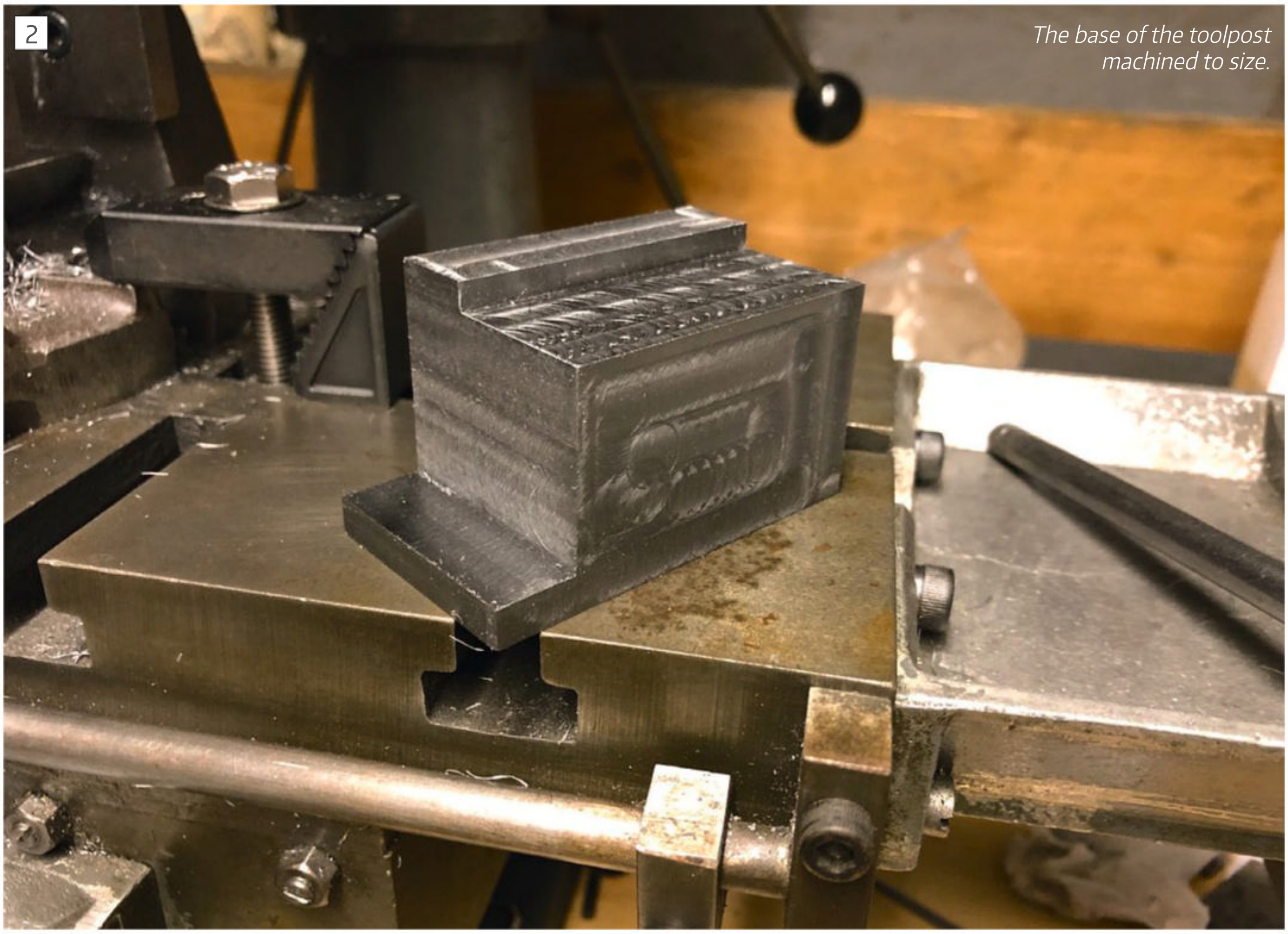
A need arose for me to make 52 wagon wheels. I decided that for speed in batch production (pity the poor wee Hobbymat) it would be a good idea to make a back toolpost, **photo 1**. Such a toolpost works 'upside down' behind the work and for much-debated reasons allows parting off with less tendency for the tool to chatter or dig in. Although the job in hand did not involve stainless steel, a future job might so I decided to make a toolpost to accept the RDG parting tool which uses replaceable carbide inserts.

One of the many shortcomings of the Hobbymat is that the cross slide is rather small. In order to obtain any use from the parting tool the holder would need to be set back off the slide cantilevered out. In order to maintain a decent theoretical length of attachment



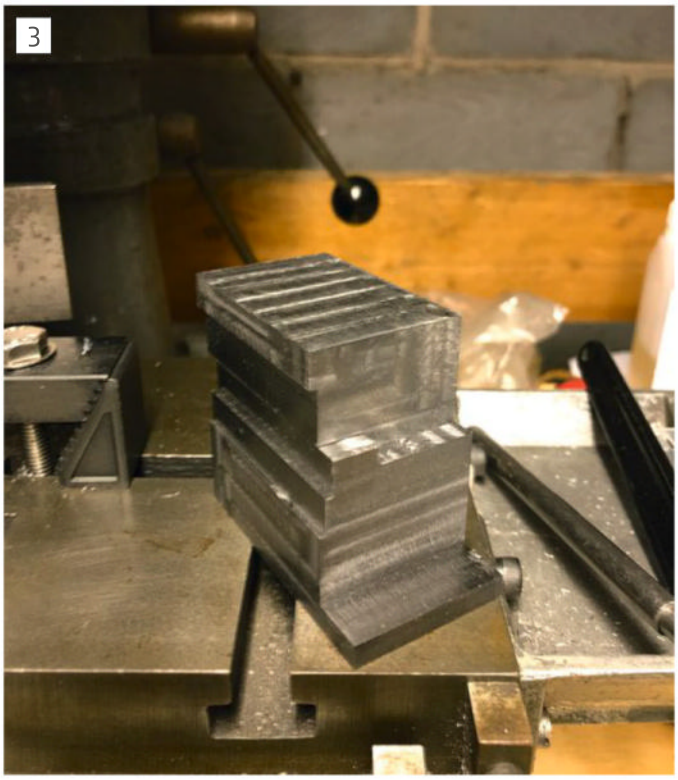
This is the base of the toolpost on a drawing of the first iteration of the toolpost. With a small mill such as mine a hacksaw is one's friend to hog out the rough shape.

2



The base of the toolpost machined to size.

3



The top and bottom halves of the toolpost machined and awaiting drilling and tapping. The two parts are out of linear register in order to demonstrate that they are two parts.

4

This is the RDG Tools parting tool block.

to the cross slide a lug was designed for attaching the front of the toolpost.

Centre height was obtained by machining some bar stock to a known dimension and then measuring the distance from the topslide to the turned stock. That dimension plus the turned radius gave the centre height. On mine it was 33.5mm. You would be best advised to follow this procedure on yours as having followed Alan Wain's instructions for a fixed steady for this machine, I can attest that not all Hobbymats are identical. If your centre height is greater or less than 33.5mm it will be necessary to adjust the dimensions on the drawings.

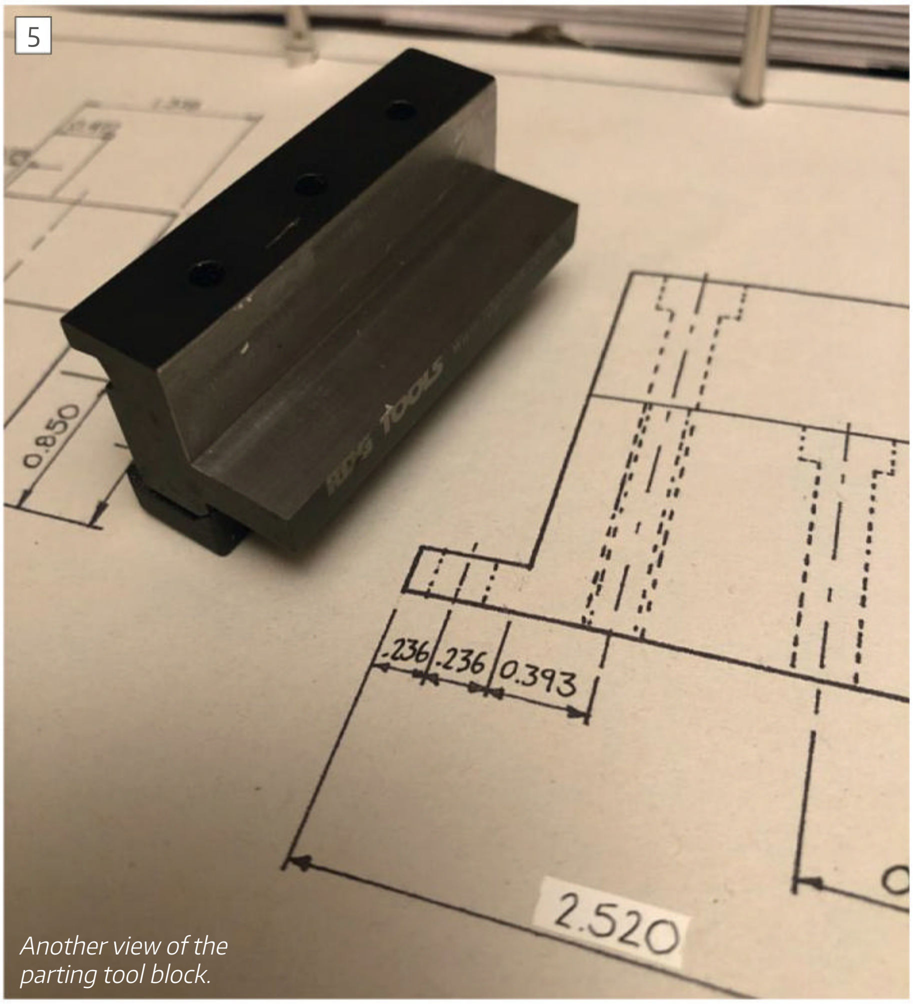
Photographs 2, 3, 4, 5 and **6** show various aspects of the toolpost.

The machining itself is pretty straightforward just slow on my little Dore Westbury. The hacksaw is a good friend to those with small mills and I hogged my stock to rough shape from 1 1/2" square mild steel.

The dimensions do need to be accurate or either the block will not grip the toolholder or it will be out of square so be sure to hit the numbers.

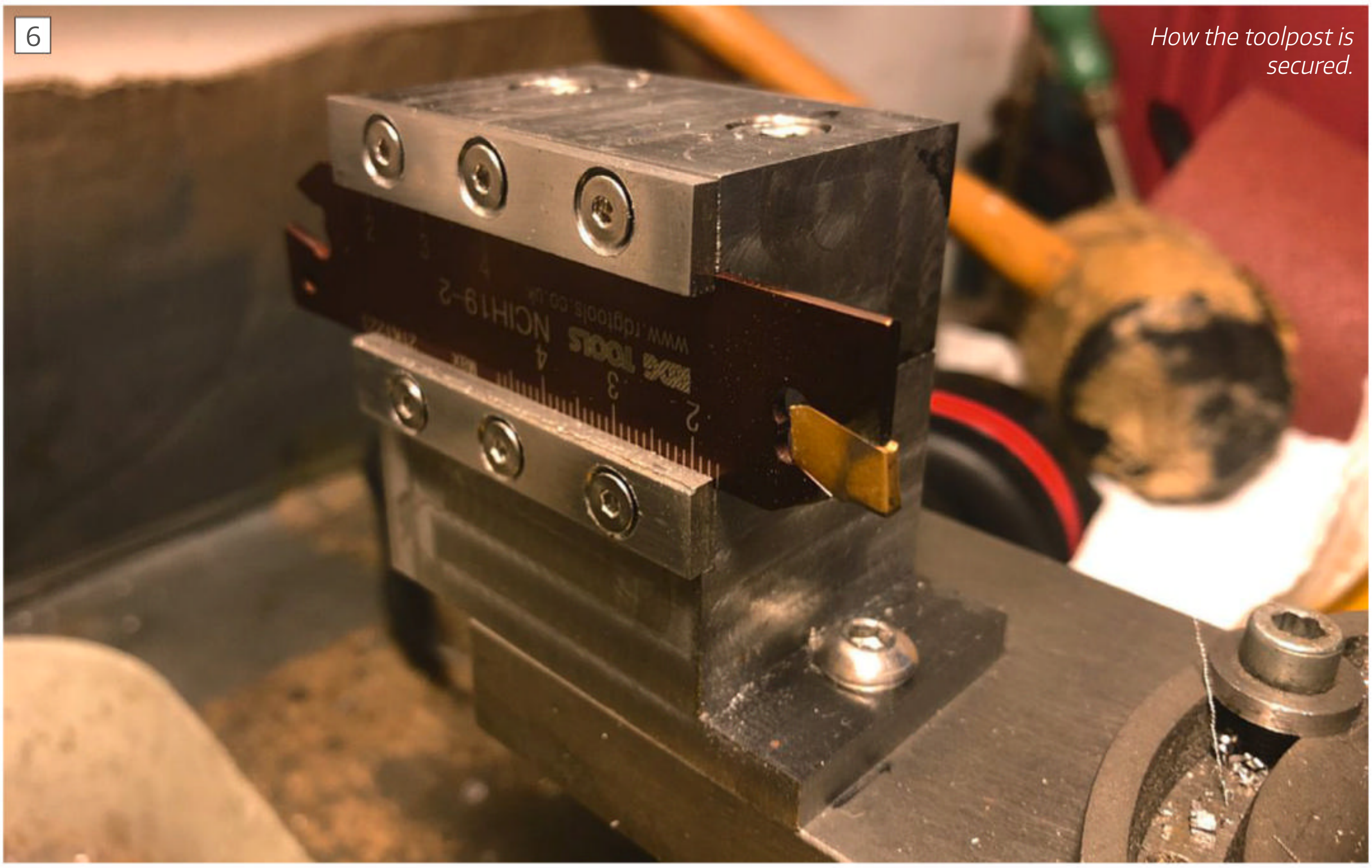
The toolholder is retained in the block by two strips of 52 x 8 x 3 BMS secured with 3 no. M3 x 10mm CSK screws.

5

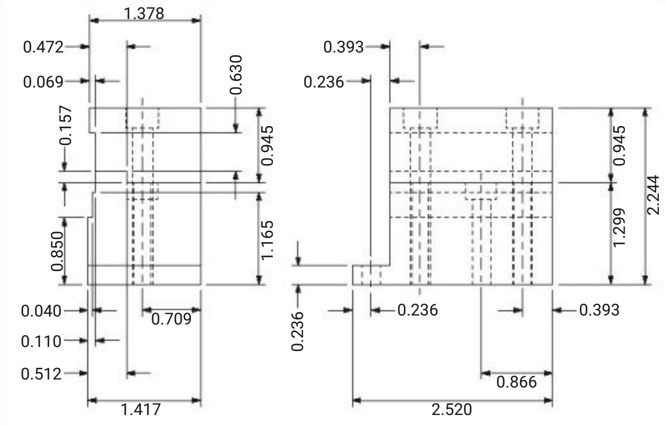


Another view of the parting tool block.

6

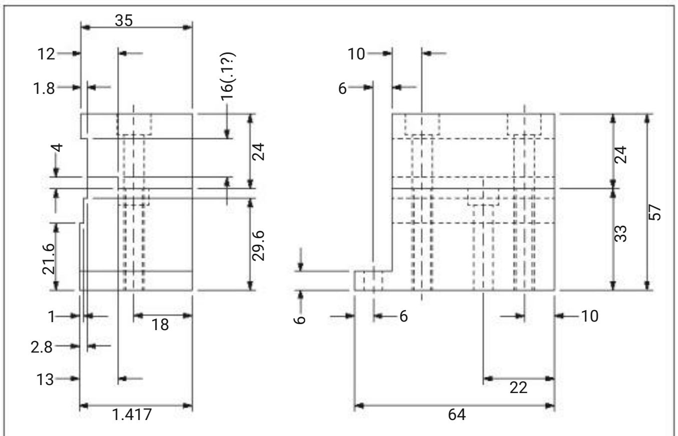


How the toolpost is secured.



Hobbymat Rear Tool Post
Imperial version

Figure 1



Hobbymat Rear Tool Post
Metric version

Figure 2

Countersunk screws are used to present less projections for fouling and snagging.

The base of the toolpost was positioned on the cross-slide lining it up with the edge with a piece of high speed steel and with the rear hole 5mm in from the back of the cross slide. The block was clamped down and the front fixing hole spotted through. The slide was then removed to the pillar drill and drilled and tapped for M6.

The cross slide was then re-fitted to the lathe. The base block was now attached to the cross slide by the front screw an M6 mushroom head screw. The screw was gently nipped up. The carriage was run along the bed towards the tailstock and a dial gauge on a magnetic base placed on the bed. The dial gauge plunger was touched onto the left face of the toolpost and zeroed. The crosslide was run in and out and the toolpost adjusted until there was no runout. The toolpost was again clamped to the cross slide and spotted through. The toolpost was removed again and the hole drilled and tapped M6 on the pillar drill. The toolpost was then secured with M6 an M6 caphead screws, the top secured with two M6 capheads and the retaining strops with their 3 CSK M3 screws each. The M6 bolts should be fully tightened once the tool is inserted inverted in order to grip the tool.

Figures 1 and **2** show the general arrangement of the toolpost with both metric and imperial dimensions. These two drawings do not show the two strips which retain the parting tool laterally. Those are just two bars, 52 x 8 x 3mm, retained with M3 x 10mm CSK screws. I countersunk because the less projections the safer around a chuck. ■

In our Next Issue

Coming up in issue 335, January 2024

On sale 15 December 2023

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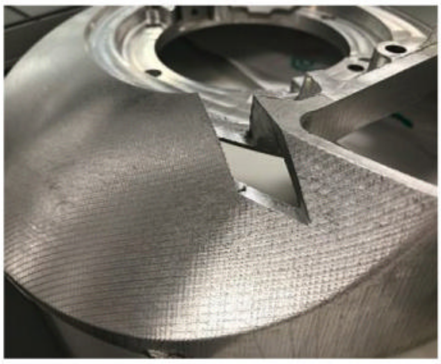
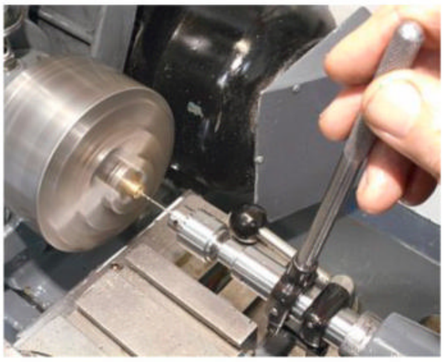
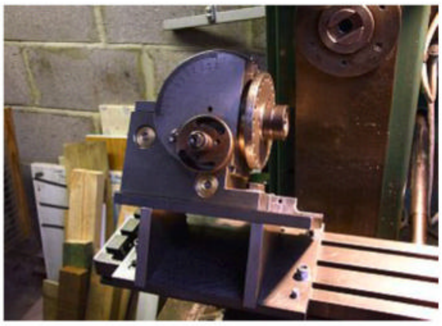


Kusti Nyholm introduces his machine control system EazyCNC.



Peter Barker explains how to make a sensitive drilling attachment for your lathe..



Brian Wood describes an angled platform to make using a dividing head easier.

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Readers' Tips

CHESTER MACHINE TOOLS

Get a grip on small workpieces.

TIP OF THE MONTH WINNER!

This month's winner is Graham Sherwood of Northwich with a handy solution to holding small objects in a bandsaw.

One for bandsaw owners - holding very small items for cutting:

I don't expect this to be an original idea but has saved me a load of time so thought I would pass on.

We all know a well set up bandsaw can make a reasonably accurate cut, the issue using one with small parts is usually securely holding small parts for cutting. This idea uses an appropriate work holding device - a lathe chuck in this case - in the saw vice itself.

I am working on a job that involves lots of turning then parting off. On smaller diameter stock repetitive parting off is fine, but there comes a point where you just want to cut it off quickly and move on!

I am lucky enough to have recently acquired a new 3-jaw to replace the aging 4" one I inherited with my lathe. So I have a spare but well used chuck I don't mind gripping in a vice.

After parting off for the umpteenth time, and with lots to go, my eye fell on the old chuck. Would this chuck fit in the bandsaw vice? If a 3-jaw is good enough for turning, it will be good enough to support cutting.

Without the sort of support a chuck can give, there is no way the bandsaw vice, with its large gap from vice to saw blade would be able to hold this small part. Using the lathe chuck in the vice I can turn a part, transfer it to the saw chuck vice, cut it off, then onto the next one in half the time.

The sawn face then needs to be faced back in the lathe, which it maybe doesn't with parting, but both methods would need a clean-up of some description, possibly chamfering etc.

Also don't forget to manually support the blade at the end of the cut - there could be a drop of a few inches, i.e. the radius of the chuck, down onto the stop switch!

We have £30 in gift vouchers courtesy of engineering suppliers Chester Machine Tools for each month's 'Top Tip'.
Email your workshop tips to neil.wyatt@mytimemedia.com marking them 'Readers Tips', and you could be a winner. Try to keep your tip to no more than 600 words and a picture or drawing. Don't forget to include your address! Every month we'll choose a winner for the *Tip of the Month* will win **£30 in gift vouchers from Chester Machine Tools**. Visit **www.chesterhobbystore.com** to plan how to spend yours!

Please note that the first prize of Chester Vouchers is only available to UK readers. You can make multiple entries, but we reserve the right not to award repeat prizes to the same person in order to encourage new entrants. All prizes are at the discretion of the Editor.

On the Wire

NEWS from the World of Engineering

What's new with 3D scanning?

Demand for 3D scanning continues to grow rapidly as more and more people become aware of the opportunities 3D scanning, reverse engineering and inspection can provide. From dramatically improving efficiencies in an inspection department, to the ability to quickly convert scan data into useable CAD drawings, we have helped guide many businesses through their 3D scanning journey.

Mintronics have been partners with Shining 3D for many years now. Shining are known for bringing high quality hardware into the market at an affordable price – It has meant that in recent years 3D scanning has become much more attainable to SMEs.

Mintronics stock the Einscan SP V2 which is ideal for reverse engineering smaller components and hobbyists. Einscan SP V2 is the upgraded version of the Einscan SP which provides a considerable improvement in scan speed. It has a single scan time of 1 second and a 360° scan time in auto scan mode of 45 seconds. Ithas a simple setup with automated calibration and uses safe structured white light.

If you have a challenge you think 3D scanning can help with, Mintronics would love to hear from you. Email business@mintronics.co.uk or give us call on 0844 357 0378.

Airbrushes.com to stock GodHand Tools.

GodHand Tools is a Japanese company that specialises in producing high-quality precision tools for hobbyists and professionals. Their products include precision cutters, pliers, tweezers, files. One of their most popular products is the God Hand Ultimate Nipper, which is a precision cutter that is specifically designed for use in plastic model building.

Shape Changing Aircraft

Aircraft capable of changing their shape during different flight conditions is proposed as a way of addressing two of the most important challenges for the future of sustainable aviation: weight reduction and increased efficiency. These challenges are being addressed by the NABUCCO research project by Professor Chiara Bisagni from the Department of Aerospace Science and Technology at Politecnico di Milano.

This is a new area, different from existing 'swing wing' technologies. NABUCCO develops radically new concepts of adaptive composite structures capable of changing their shape by exploiting the phenomenon of structural instability. This will be applied to next-generation aircraft. In aeronautics, structural buckling is generally avoided as it can instantly generate large deformations and even cause a catastrophic collapse.

Conversely, NABUCCO no longer sees structural instability as a phenomenon to be avoided, but as a design opportunity to be explored for its revolutionary potential. The idea is to use the disadvantages of instability in a positive way to conceive, design and build composite structures - and in particular adaptive wings. Professor Chiara Bisagni will develop new design, analysis and optimisation methods based on analytical formulations, neural network algorithms and an integrated, multidisciplinary design approach.

Full Steam Ahead for MGRS Saturday 2nd & 3rd March 2024

Plans are "on track" for the 2024 Midlands Garden Rail Show taking place on Saturday 2nd & Sunday 3rd March for one of the leading model railway events dedicated to garden rail at Warwickshire Event Centre.

This event features the larger gauges of O Gauge, G Scale, Gauge 1, 16mm and more. Confirmed layouts include Blackgang in Gauge 3 and the Gauge 1 Vintage Tinplate Trains Group.

Confirmed clubs include the Bromsgrove Society of Model Engineers and the National 2 ½" Gauge Association.

Over 30 leading suppliers will be at the show to help you create your dream garden railway selling everything you could need including locomotives, rolling stock, track and accessories.

For further details on the exhibition and to book tickets see www.midlandsgardenrailshow.co.uk.

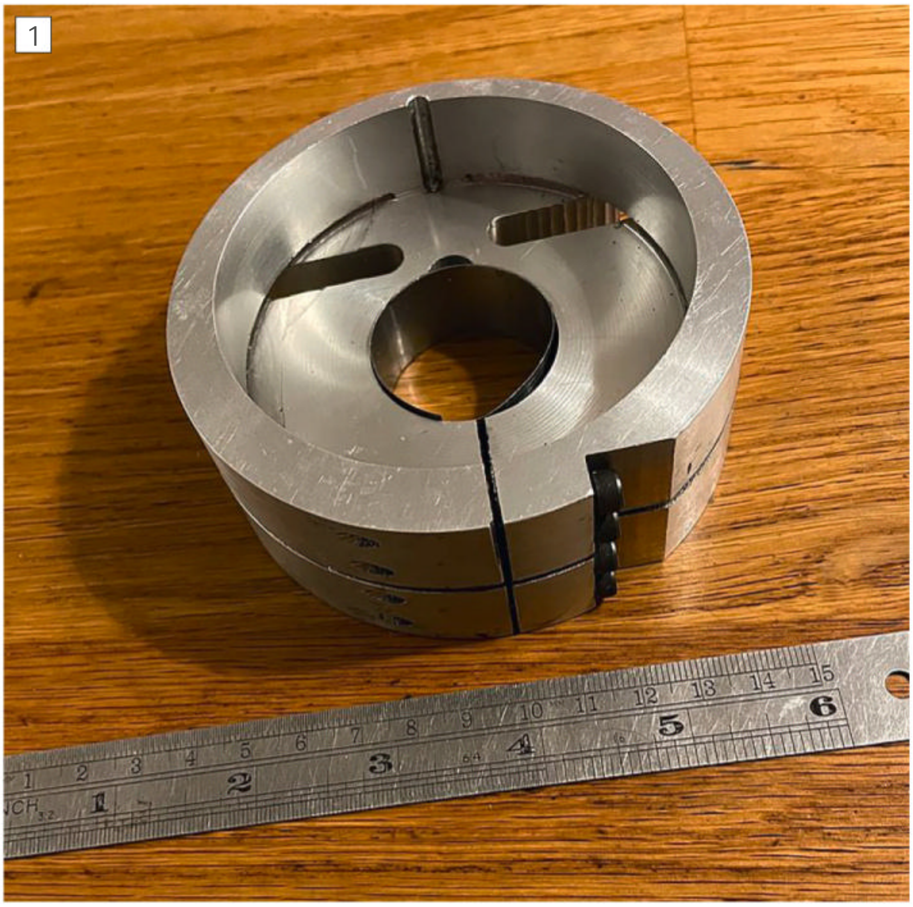
Making an Internal Gear

Internal gears cannot be made using the usual processes for normal gears. Chris Hobday approached the task by broaching a gear in his Vertical Mill.

I wanted to machine an internal gear but, having never done so before, was initially uncertain as to how to do it and what machine to use. This article relates how I tackled the task, describing both how I set up the machine - I ended up using my vertical mill/drill - to be able broach and then the manufacturing of the internal gear itself.

Over the past few years, I have been working, on and off, on finishing a three cylinder radial aero engine that was part built by a model engine builder who had sadly died with the engine half finished. Progress has been very slow, as the work is fitted in between doing other jobs/ projects that come up with a higher priority, but recently I progressed onto the drive for the cams, which involved an internal gear.

Now, the likelihood of finding exactly what I required in an internal gear was significantly less than of me winning the lottery, so I decided to machine it myself - and isn't that what this hobby is all about, the satisfaction gained from making as many parts as possible yourself with whatever facilities you have; but how to do it was the question.



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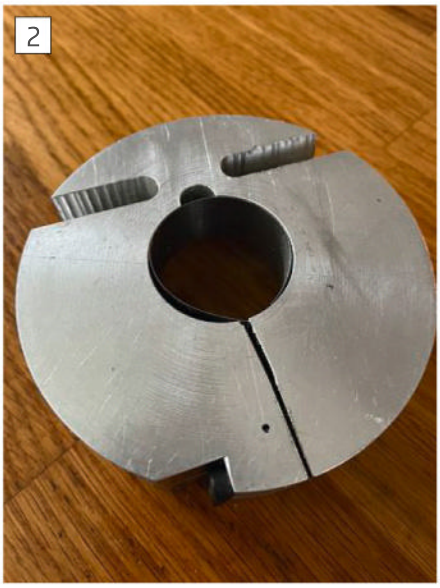
Quill clamp top view

I should say here that the part-built engine came devoid of all plans. So, as I am not one of those lucky people who can machine up parts to fit a design working entirely from my imagination on an idea carried only in my mind, the first job was to draw up the engine as it was, then design all the missing bits, and then produce working dimensioned drawings.

This design included all the valve actuation, with the cams, cam support ring and cam drive being the basis, or start, of the valve actuation train. I drew up a simple holder for two cam rings, inlet and exhaust, supported by twin ball bearing races mounted on the crankshaft output shaft, driven by a spur gear off the crankshaft, via an idle gear, to an internal gear fitted to the cam support ring, such that the cam ring rotated in the opposite direction to the crankshaft. So far so good, and so far, so conventional, but the gear train required an internal gear ring.

Making the spur gears for the drive has been covered by many and posed me no problems, but an internal gear - now there are not many who write about making these and so with nothing to go on I pondered on how to do it for quite a while. Then, on the internet, I came across a model-maker who was making an epicyclic gearbox for a model vehicle he was making, necessitating the manufacture of an internal gear. He tacked the internal gear manufacture by making an adaption to his lathe, to allow him to index the chuck (which was holding the internal gear blank) around, like a dividing head, allowing him to form the right number of teeth by using an arrangement of his top slide and saddle as a broach to cut the gear. That set me thinking along similar lines, but I decided not to follow him in adapting my lathe but thought that it would be possible to use my vertical mill instead.

Now my vertical mill is a Warco 'Economy' mill/drill, a round column



2 Quill clamp underneath view

3 Mill quill clamp

4 Quill and sleeve

mill/drill, being a smaller version of their "Major" mill/drill, and one of the last ones I believe Warco sold of this model. The major problem to resolve of using a vertical mill/drill is that the quill is designed to go round and round, obviously, but no facility is understandably made or provided to hold the quill locked and unable to turn, so a locking fixture had to be designed and made.

The quill revolves within a support sleeve, for want of a better word; both move up and down together, but the sleeve does not rotate. This fact provided the means to an end.

The other issue - I was going to say problem but it is not a problem really, just something to consider - is that to use the quill as a broach may possibly inflict stresses on the quill mechanism to which it wasn't designed to cope. However, as I was designing the internal gear I could also pick the material; I considered that the use of aluminium, whilst maybe not ideal as an internal gear, in this application would be sufficient. The model is not going to be used in active service - if I get it to run at all it will be a bonus - so is likely therefore to only have limited running, so wear should not be a problem. The load on the gears driving cams on a radial engine I didn't think would be that high to cause a major problem anyway, especially given the limited run time, and besides, people make gears out of brass and plastic all the time so for me aluminium would be fine and relatively easy to cut. It's not as if I was cutting high carbon steel for instance, so I considered the 'new' stresses to be not significant in this application. In any event, the quill takes stresses imposed upon it in normal milling operations, so I felt I was possibly over-thinking this, but better to have considered it and reassured myself, than not to have considered it at all and been undone, as it were.

So the first job was the clamp to lock the quill. I designed a simple clamp from one piece of round aluminium, in my case of 4 inches diameter stock to give an idea of size. I am not going to provide other dimensions, as anyone thinking of going down the same route will make it to fit their own mill, which will be undoubtably different to mine! The clamp design would enable it to clamp onto both the quill and the sleeve separately but be locked together. Then both quill and sleeve could go nicely up and down together as usual but the quill could not go round and round.

Photographs 1, 2 and **3** show the clamp from various angles so a good impression can be gained of the item, **photo 4** is the quill and sleeve before

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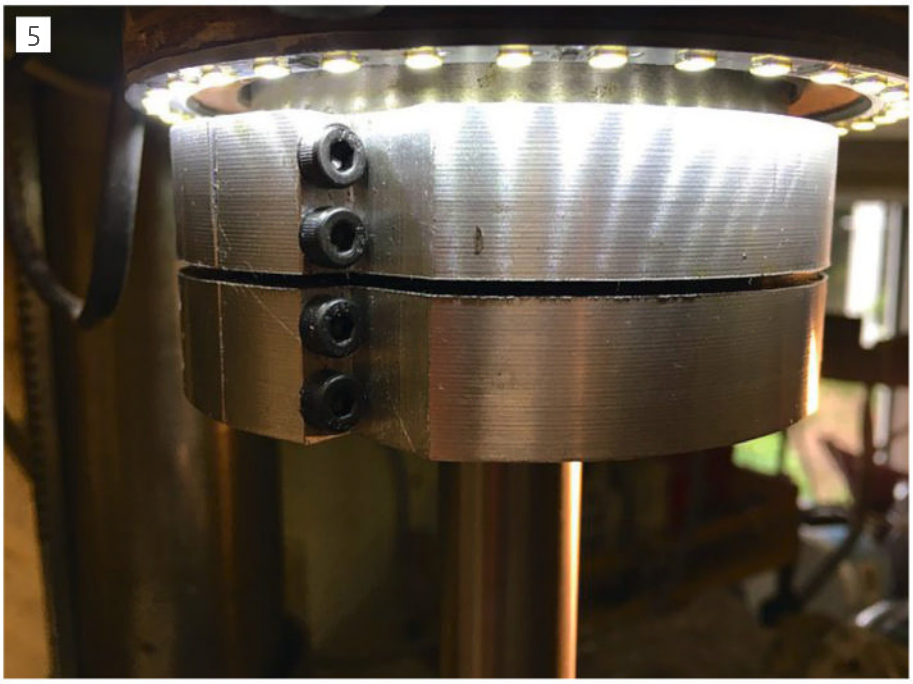


Clamp (and tool) in position

Broaching tool

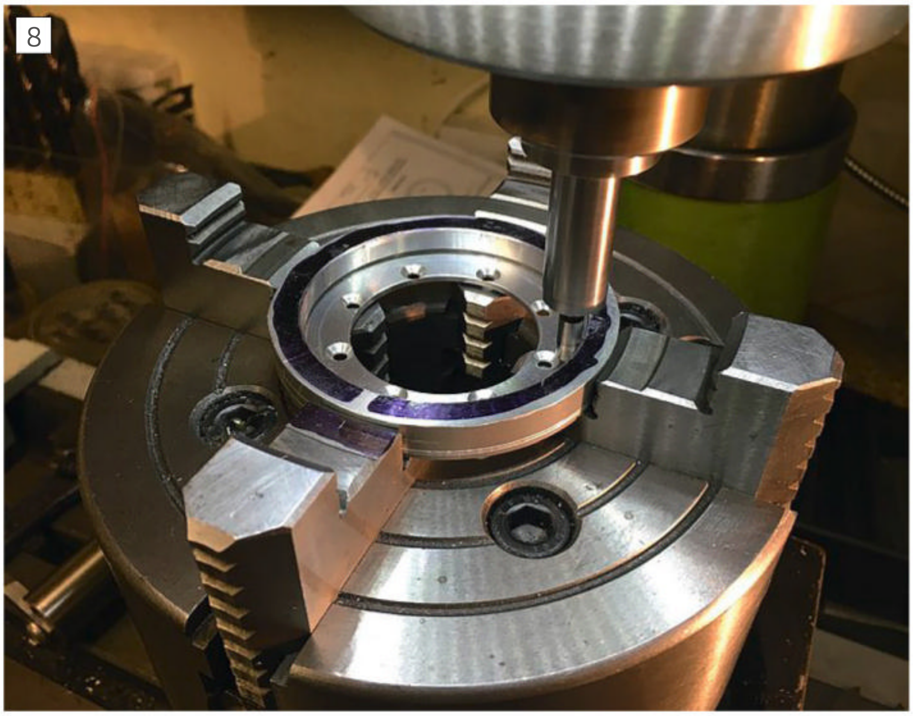
fitting the clamp, and the clamp fitted in **photo 5**. The broaching tool is also fitted in photo 5 but just the holder is showing at the bottom (the 12v LED lighting was an experiment and was just fitted temporarily at the time). Basically, it can be considered to be two clamps, each to suit a different diameter, both able to clamp independently but joined at the hip, so to speak, so they are as of one piece. As can be seen from the photos, the section joining the two clamps is very small, but effective in practice.

The holes through the clamp are offset from the centre of the round billet to allow for the inclusion of the two sets of M4 securing bolts on the thicker side of the clamp circumference. The stock was set up in the 4-jaw chuck on the lathe to run approximately true, exact true running was not required at this point, and the front and back faces cleaned

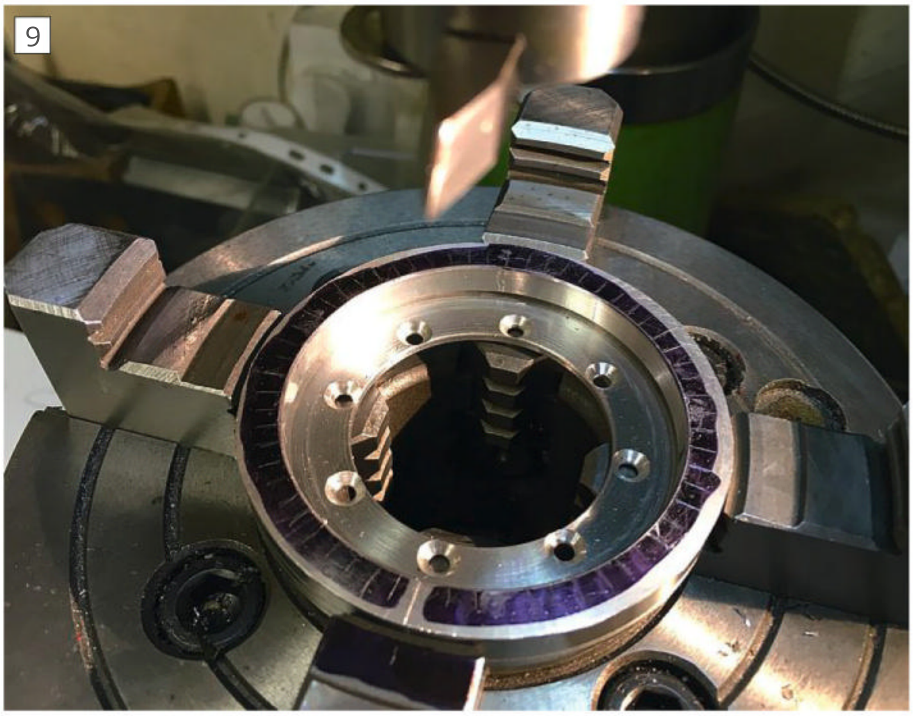
Broaching tool

up. The piece was then marked out to provide a centre for the eccentricity of the through holes and then set up again in the 4 jaw to run true to the eccentric centre. The holes for the quill and sleeve are concentric, obviously, so the hole to fit the quill was drilled and bored to size first, and then the upper part was further bored out to fit the sleeve. As can be seen from the photos, I slightly over bored the quill bit and so fitted a wee shim to help the clamp operate without undue pressure being required on the clamp bolts to secure it.

Having done all the lathe turning operations, the piece was transferred to the mill. First the step for the M4 bolt socket heads to sit on were milled and the bolt holes drilled through at M4 tapping size before this was opened up to a clearance size in the top (bolt head) half and then being tapped M4 in the mating bottom half. Relief slots were milled out as can be seen to allow the clamps to move in more easily, and then the clamp was slit vertically and horizontally with a slitting saw to finish the job. You can see easily how it is all arranged, (and also in one part where I was a little out in set-up and so got a bit messy with the slitting blade!) but as said earlier, it has not been dimensioned as if anyone makes one, the sizes will be dependent upon their own mill. In operation it clamped up very easily and held the quill locked very hard indeed with very little pressure required from the M4 socket head cap bolts, so I must have got the relief slots right!



Centering the gear blank



Start mark and stations

The broaching tool, **photos 6** and **7**. I made a simple holder to hold a piece of 1/4" HSS tool steel, the top bit of the holder being held in a simple morse taper collet in the quill, with two flanged socket buttons to hold the HSS tool in place. Although the photos show only one flanged socket button for clarity, in use two were used. I could not find much information on the profile of internal gears - there is plenty available on spur gears! - so I followed the example of the (inspirational) internet model maker and decided to cut just straight vee 'holes' between the teeth. This made grinding the tool up easier as it just had to be ground to a simple vee angle to suit the pressure angle, in my case to 40 degrees. It seems to work so far!

So, to the internal gear. I had made a gear blank up with a piece of aluminium stock set up in the 4-jaw chuck. The back had been faced off, the piece turned round in the chuck, set to run true, faced again and all internal turning done, leaving the external diameter oversize until final finishing later when mounted on the cam support ring. The four-jaw chuck was removed from the lathe without disturbing the gear blank and remounted on the rotary table, which had been previously centred under the quill on the milling table, and the securing holes drilled and countersunk using the "holes on a circle" function on the DRO.

It was a some time later that I got to do the broaching. The design called for cutting a 60-tooth internal gear, so I had already set up the rotary table as a divider with a suitable division plate to give 60 teeth. The 4-jaw chuck, still holding the internal gear blank, was fitted to the rotary table and centred using an edge finder, **photo 8**, and the mill's DRO. The mill table was then locked in the X axis. Using a point in the now centred quill a mark was made on the gear blank on the Y axis centreline, **photo 9**, nearest to me. This gave me a target to aim at for lining up the broaching tool. Mounting the broaching tool in the quill, I then dropped the quill down and lined up the tool with the witness mark I had just made, and then very carefully, checking all the while, locked the quill off for the first time in anger. Greater accuracy might have been made by scribing two lines on the blank as witness marks, either side of the tool centreline 1/4" apart, but I was confident that lining up the point to the single witness line would be sufficient, certainly to within a thou or so.

Then, watching the DRO, I brought the tool up until it just touched the internal diameter of the blank in way of the gear teeth position, and zeroed the Y co-ordinate. Then I lifted the tool up a bit to clear, wound the tool towards me in the Y axis to the full depth of cut and zeroed the Y co-ordinate again. I now had a depth to work to - I was all good to go.

But first a check. For the broaching on the mill/drill I was using the drill motion function. Normally, unless I am drilling something and sometimes not even then, to avoid knocking my head I have the three drill hand levers unscrewed and removed. Even though I have

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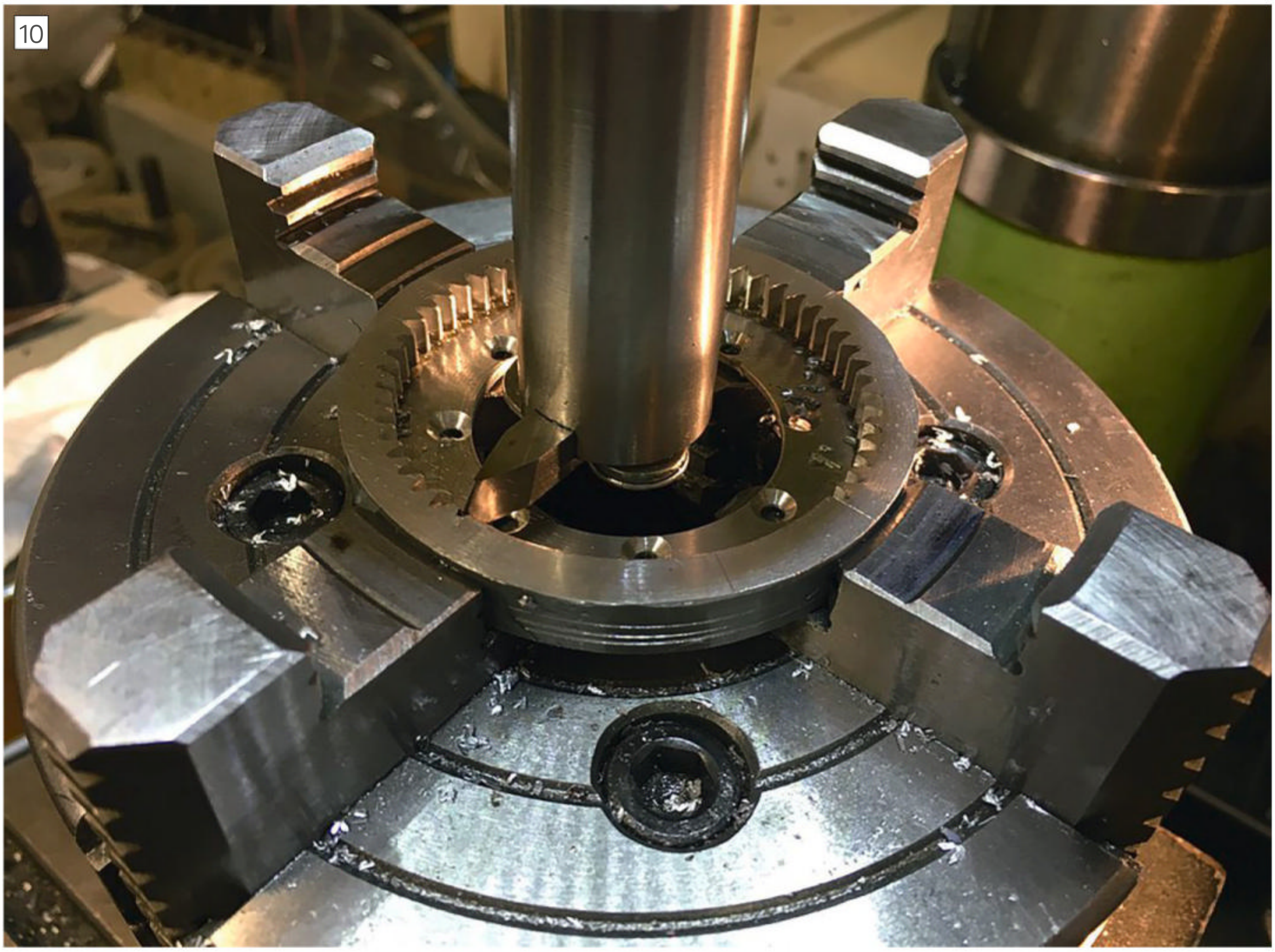
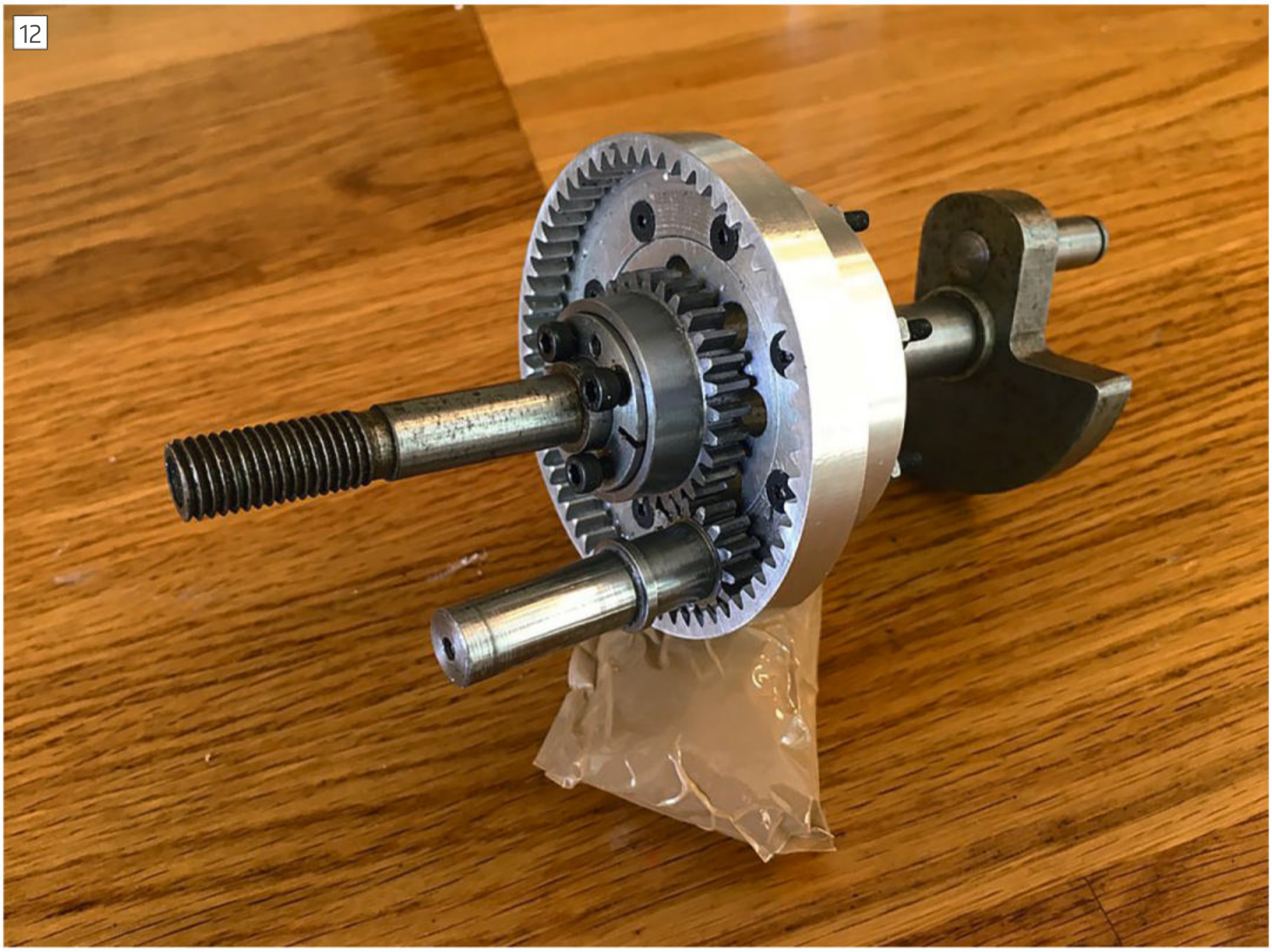


Broaching in progress

Completed internal gear

already shortened the drill handles, for my preference, they still can get in the way of my head when I am looking close up to the work when setting up; so they were now refitted. Using them I lightly scratched the blank with the broaching tool then indexed round to each station in turn, making a mark, checking at each position, until back to the start, to ensure I was doing an actual 60 tooth internal gear as required, and not 61 or 59 tooth or some other random number instead! Always best to check these things first before any damage is done and there is still the ability to correct any set up errors with no damage being suffered by the part. And just to reassure the health and safety conscious - the mill electrical supply (other than for the DRO and lights) was disconnected for the whole operation. Again, better safe than sorry. Finally, I set the depth stop on the tool travel to ensure I did not go banging the tool into the backing plate in my enthusiasm!

Having done all the checks, now to cutting some swarf. I decided to take each tooth cut - or to be more accurate, cut the material in the space between each tooth - down to nearly full depth at each station in turn, before indexing to the next station. I started off by taking cuts of a few thous of an inch at



Completed gear train

a time, taking several passes at each cut until the tool felt 'free', going further and deeper into the material until the effort to take the cut started to increase, whereupon I reduced the depth of cut gradually until I was only taking off about a thou at a time deep in, until I was a few - 3 or 4 - thou off full depth of cut. I then moved onto the next station and repeated the process, **photo 10**.

I very quickly realised I had made a mistake in design. I had not allowed enough space between the bottom - or inner end - of the teeth and the backing plate. This was really stupid of me as there is enough space within the engine crankcase to allow for a much bigger gap, but what it meant was that there was nowhere much for the swarf to go. It just ended up jamming at the bottom of the tooth between it and the backing plate, such that the tool would not complete the full stroke. So I had to make up a little angled picking tool and use it to regularly clean out the swarf as I went along; the deeper in, the more swarf, the more frequent the clearing out. This of course made the whole process, already a slow job, even slower! Well, we live and learn. If I ever make another internal gear, there will be greater clearance between teeth and backing plate for sure!

When all the stations had been taken out to approximately the same depth I then went round again, this time taking a thou at a time out of each cut in turn for the complete circle of sixty teeth (or teeth gaps!), and again and again as required, until the total full depth of cut had been achieved. In this way I ensured every tooth gap was cut exactly to the same depth. I had calculated the total depth required from using formulas from Ivan Law's book "Gears and Gear Cutting" in the Workshop Practice Series of books. If you are having to cut gears then this is an excellent book to have, and no, I have no connection with Mr. Law or the publisher!

So the internal gear was cut. I have to say that it is a very slow process, albeit a very satisfying one, for me anyway, especially as I would have been unable to buy exactly what I required elsewhere. I could hardly wait until the whole cam support assembly was completed and I could assemble the whole gear train and turn it over. To my relief it all worked as it should with just minor "running in" adjustments in the gear train; I was well pleased.

Photograph 11 shows the internal gear finally completed with the outside diameter taken down to size and **photo 12** the whole gear chain completed and in position on the cam support ring, but without the cams fitted!. The drive gear on the crankshaft is secured in position by an internal taper lock bush, which allows for setting the gear timing exactly.

To some, the satisfaction gained by this manufacture may seem trivial, but to me it said it just shows what one can do if one puts one's mind to it. ■

METRICATION

by B. K. Butler

In recent issues of "Model Engineer", the subject of Metrication has been raised. Regardless of all the arguments against adopting the S.I. system, we have been informed that within three years, 75% of industry will have changed over to the new system.

As far as model engineers are concerned, sooner or later stocks of such things as bolts, rivets and sheet metals will only be available in Metric sizes. During this period, the younger generation, who we hope will be the model engineers of tomorrow, will be indoctrinated into the use of the Metric system.

Eventually this "new breed" of model makers will be looking, and hoping to find in "M.E." all plans and information etc. to the new system. We will have to convert sometime to the new system, and from what I have seen at past exhibitions etc., to men and ladies who can work pieces of inanimate steel, brass, copper, etc. into gleaming examples of miniature steam locomotives, traction engines and the like, should have no difficulty in adapting to the Metric system.

To provoke comment and discussion, I have prepared four tables illustrating briefly what we are likely to come up against in our particular hobby. In the first table I have shown the Metric recommendations for plate, strip and wire (150—R 388). This table is nowhere near complete, but I have kept it basically to the sizes we use at the moment.

A breakdown of this table to assist in understanding: Left to right. Columns 1, 2 and 3. The Legend R10, R20 and R40. These are thicknesses of material expressed in millimetres. R10 and

Below: Fig. 4

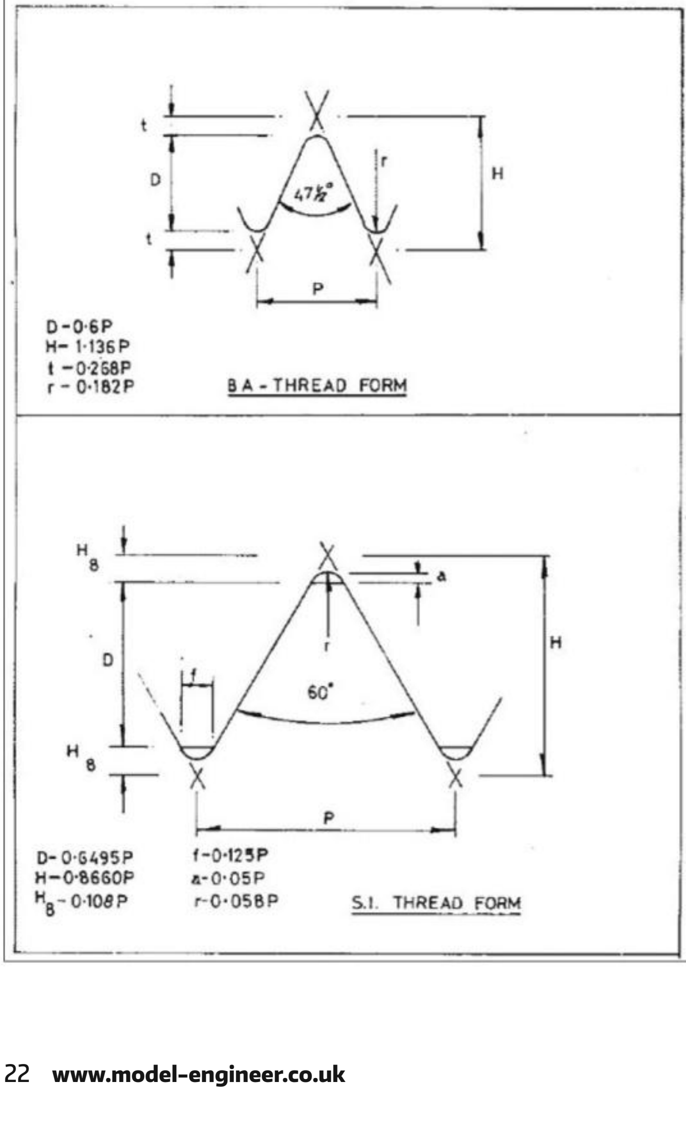


Table I

R 10	R 20	R 40	DEC EQUIV	SWG	DEC EQUIV
0,630	0,630	0,630	·024		
		0,670	·026		
	0,710	0,710	·0279	22	·028
0,800	0,800	0,800	·031		
		0,850	·033		
	0,900	0,900	·0354	20	·036
		0,950	·037		
1,000	1,000	1,000	·039		
		1,06	·041		
	1,12	1,12	·044		
		1,18	·046		
1,25	1,25	1,25	·0492	18	·048
		1,32	·052		
	1,40	1,40	·055		
		1,50	·059		
1,60	1,60	1,60	·0629	16	·064
		1,70	·066		
	1,80	1,80	·070		
		1,90	·074		
2,00	2,00	2,00	·0787	14	·080
		2,12	·083		
	2,24	2,24	·089		
		2,36	·092		
2,50	2,50	2,50	·0984	12	·104
		2,65	·106		
	2,80	2,80	·110		
		3,00	·118		
3,15	3,15	3,15	·1240	10	·128
		3,35	·131		
	3,55	3,55	·139		

From the Model Engineer Archive

To celebrate 125 years of Model Engineer magazine and the Society of Model and Experimental Engineers, each issue in 2023 features fascinating historic content from Model Engineer relevant to workshops, tools or techniques. To conclude we thought we would take a retrospective look at something that has long been a bugbear for many hobby engineers – metrication! This article by BK Butler is from volume 138, number 3440, May 5, 1972. It's fascinating that 75% of industry would change over in three years, but over fifty years later we can still obtain plenty of imperial materials.

That's the final instalment of our archive series, but not the last excerpt from a vintage Model Engineer – in future we hope to produce modern drawings of some of the wonderful classic tool designs featured in the magazine over the decades. For now, let's raise a 0.568 litre glass and make a toast to all the wonderful contributors to Model Engineer over the past 125 years!

R20 are preferred sizes, R40 is a non-preferred size. Column 4: The exact decimal equivalent. Column 5: The s.w.g., and where it appears relative to columns 1, 2 and 3. Column 6: The Decimal equivalent of Column 5.

Example: At the moment, we use 16 s.w.g. at 0.064 in. This has an equivalent in R10/1.60 (0.062 in.) but dependent on availability R20/1.40 (0.055 in.) or R20/1.80 (0.070 in.) are options.

Table 2.

This is a simple straightforward conversion of millimetre sizes to fractional or BA sizes.

Table 3.

Lists various information of Iso-Metric hexagon head bolts alongside its nearest BA counterpart.

Finally, Table 4 illustrates the BA thread form alongside the S.I. thread form.

I fully realise that this has not scratched the surface of the problems to be sorted out when the time comes. But as I have previously stated, it should serve to provoke comment and further discussion amongst the model engineering fraternity.

Right: Table 2

MM	INS	FRACTIONAL OR BA SIZES
0.79	0·031	1/32
1.59	0·062	1/16
2.20	0·087	8 BA
2.38	0·094	3/32
2.50	0·098	7 BA
2.80	0·110	6 BA
3.17	0·125	1/8
3.20	0·126	5 BA
3.60	0·142	4 BA
3.97	0·156	5/32
4.10	0·161	3 BA
4.70	0·185	2 BA
4.76	0·187	3/16
5.30	0·209	1 BA
5.56	0·219	7/32
6.00	0·236	0 BA

Below: Table 3

METRIC SIZE	DEC EQUIV	TPI	A F HEX MM	PITCH MM	EQUIV BA	DEC EQUIV	TPI	A F HEX DEC	PITCH DEC
M 2.5	0·098	56·4	5.00	0.45	7	0·098	52·9	0·172	0·018
M 3	0·118	51	5.50	0.50	6	0·110	47·8	0·193	0·020
M 4	0·158	36.3	7.00	0.70	4	0·142	38·4	0·248	0·026
M 5	0·197	31·8	8.00	0.80	2	0·185	31·4	0·324	0·031
M 6	0·236	25·4	10.00	1.00	0	0·236	25·3	0·413	0·039

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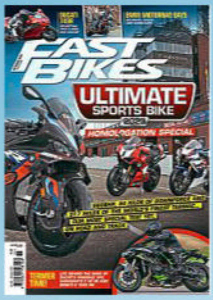

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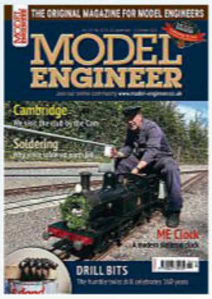

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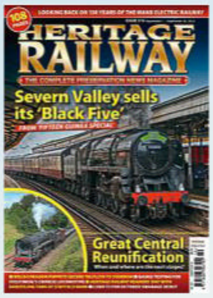

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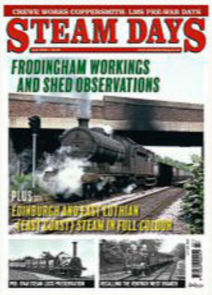

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Compact Dividing Head Part 3

Chris Hallaway designed and made this Compact Dividing Head (CDH) about thirty years ago for use with hobby size milling machines.

18 Worm Bracket

Shown in **fig. 17.** After completing the outside profile and the large bore, machine the angled mounting face for the Worm Bearing Blocks to depth. Drill and tap holes to drawing.

It is nearly always found that the bore of such parts closes up after sawing through the gap, so a retainer is provided to help force the gap open by unscrewing the M6 capscrew when a change of bracket position is needed.

22 & 23 Worm Bearing Blocks

These are best made as a pair to ensure that the bearing bores are accurately located to their bases, **figs 18** and **19**.

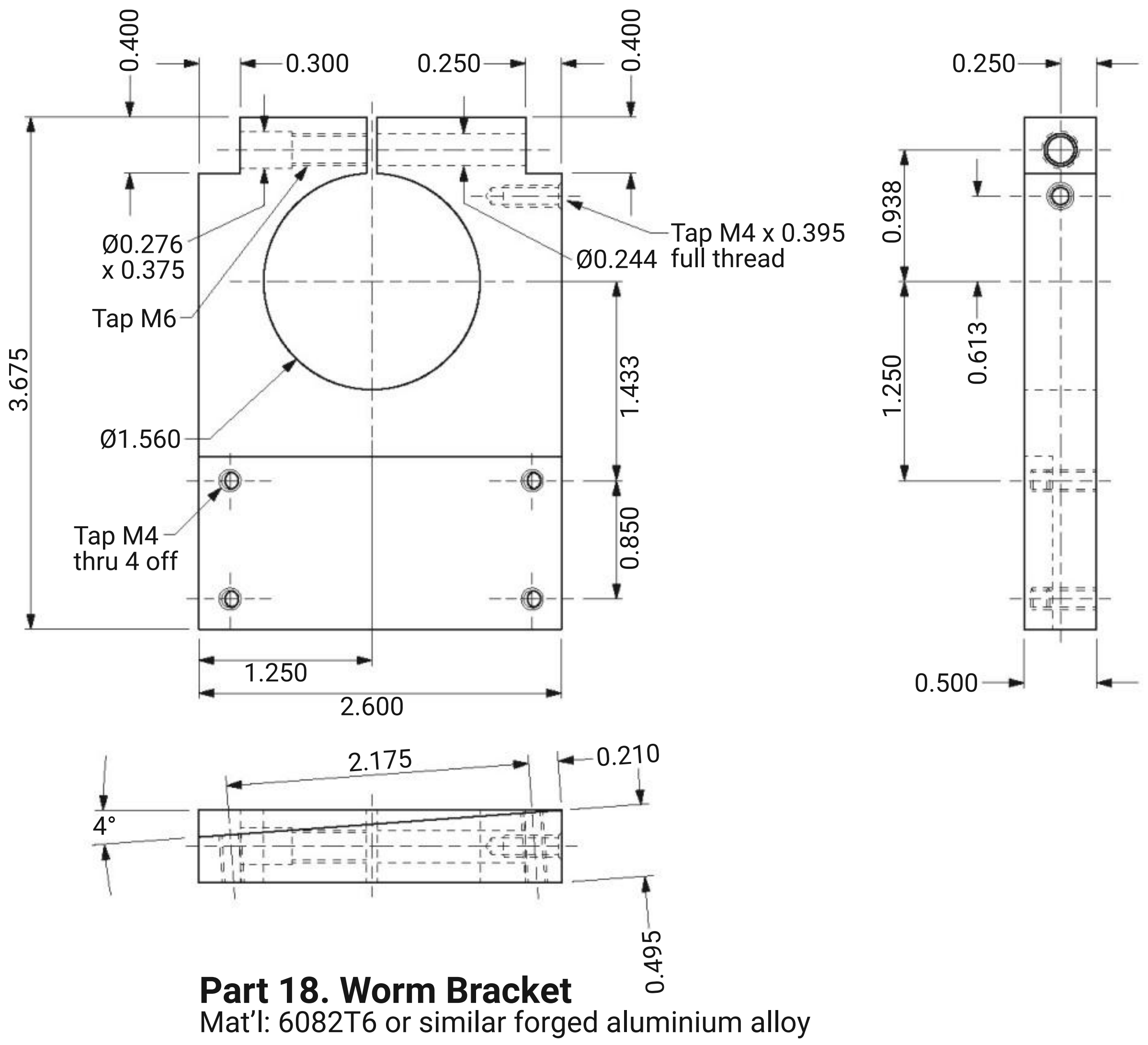
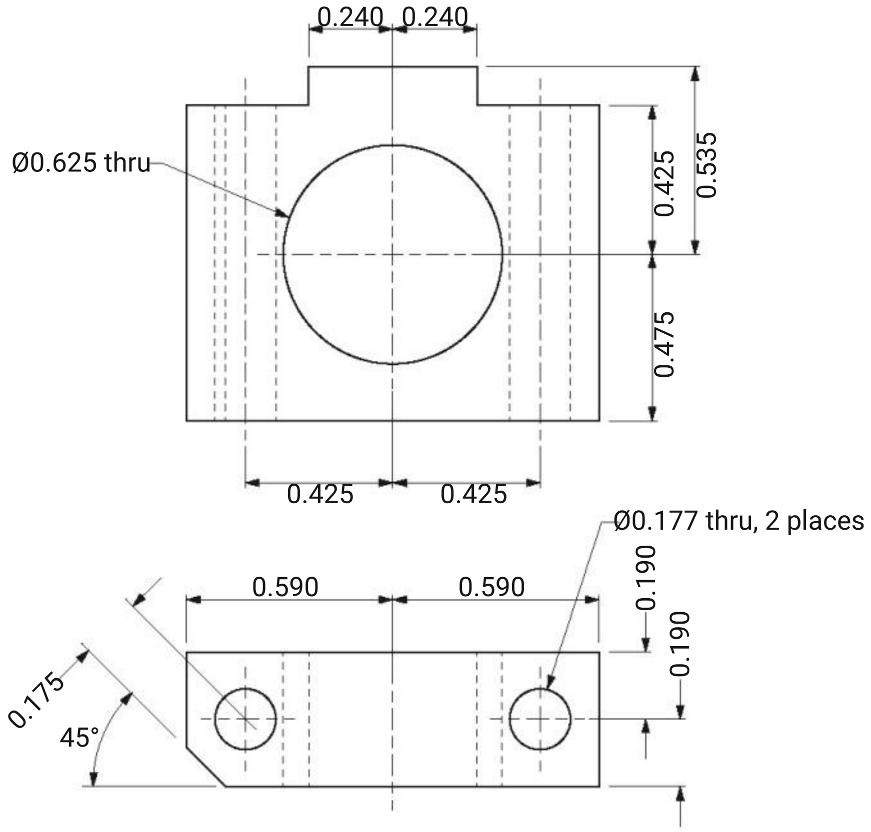
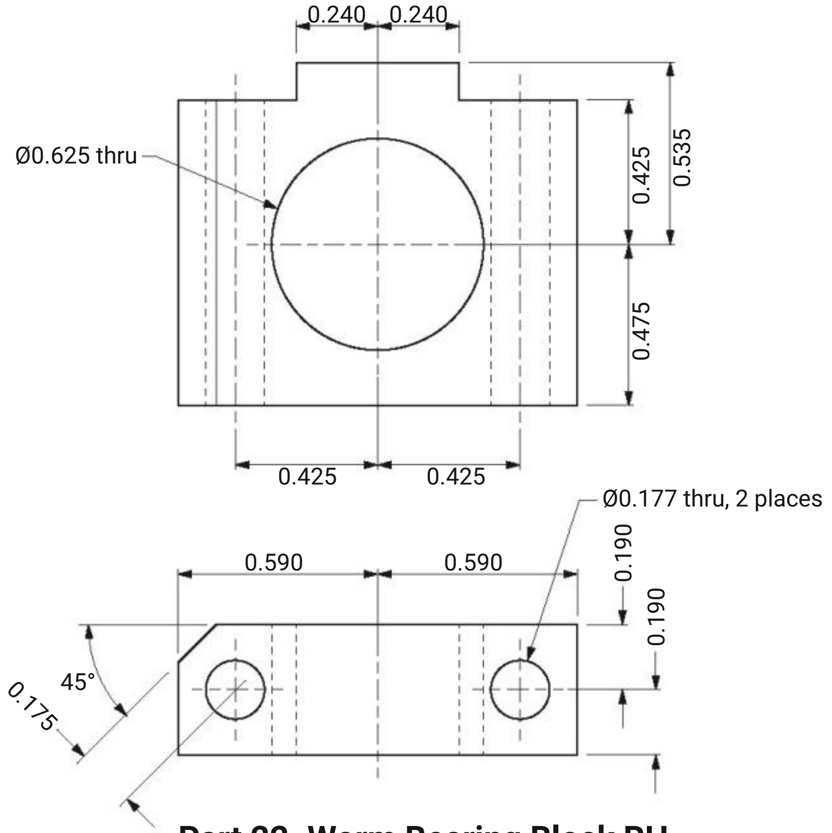


Figure 17



Part 23. Worm Bearing Block LH
Mat'l: 6082T6 or similar forged aluminium alloy

Figure 18



Part 22. Worm Bearing Block RH
Mat'l: 6082T6 or similar forged aluminium alloy

Figure 19

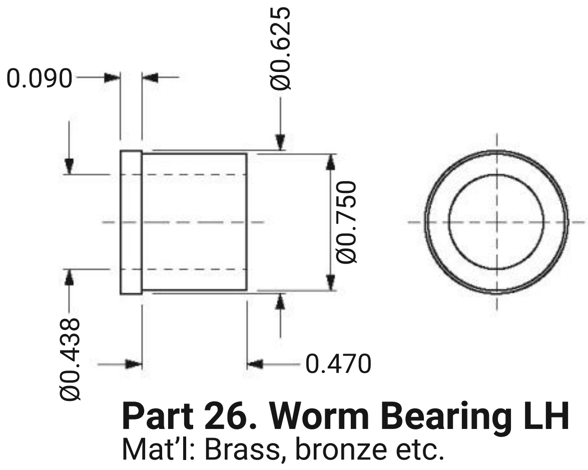


Figure 20

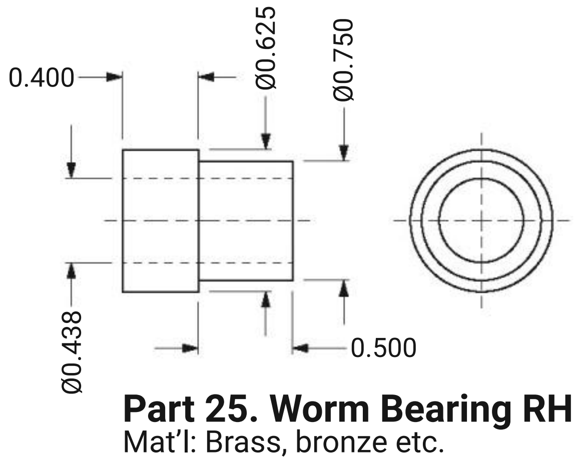


Figure 21

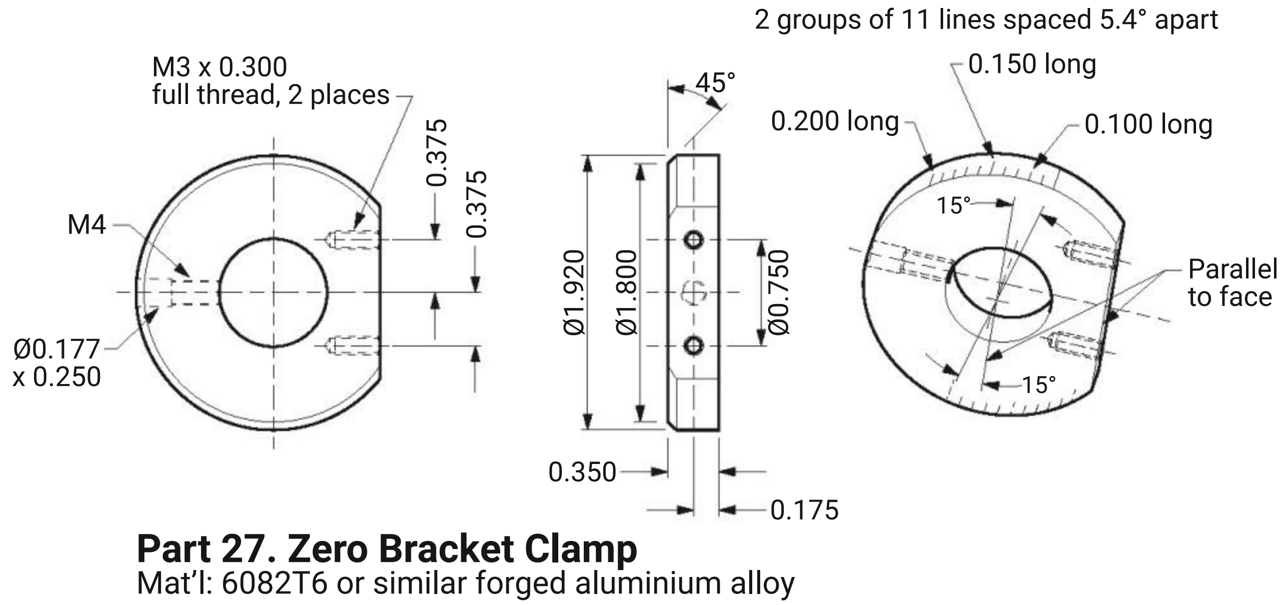


Figure 22

25 & 26 Worm Bearings

These are secured in their respective Worm Bearing Blocks either by interference fit or with Loctite. **Figs 20** and **21.**

27 Zero Bracket Clamp

Figure 22. With the stock mounted in the 3 jaw chuck machine the face adjacent to the Handwheel Dial then turn, bore and engrave, **photo 5**.

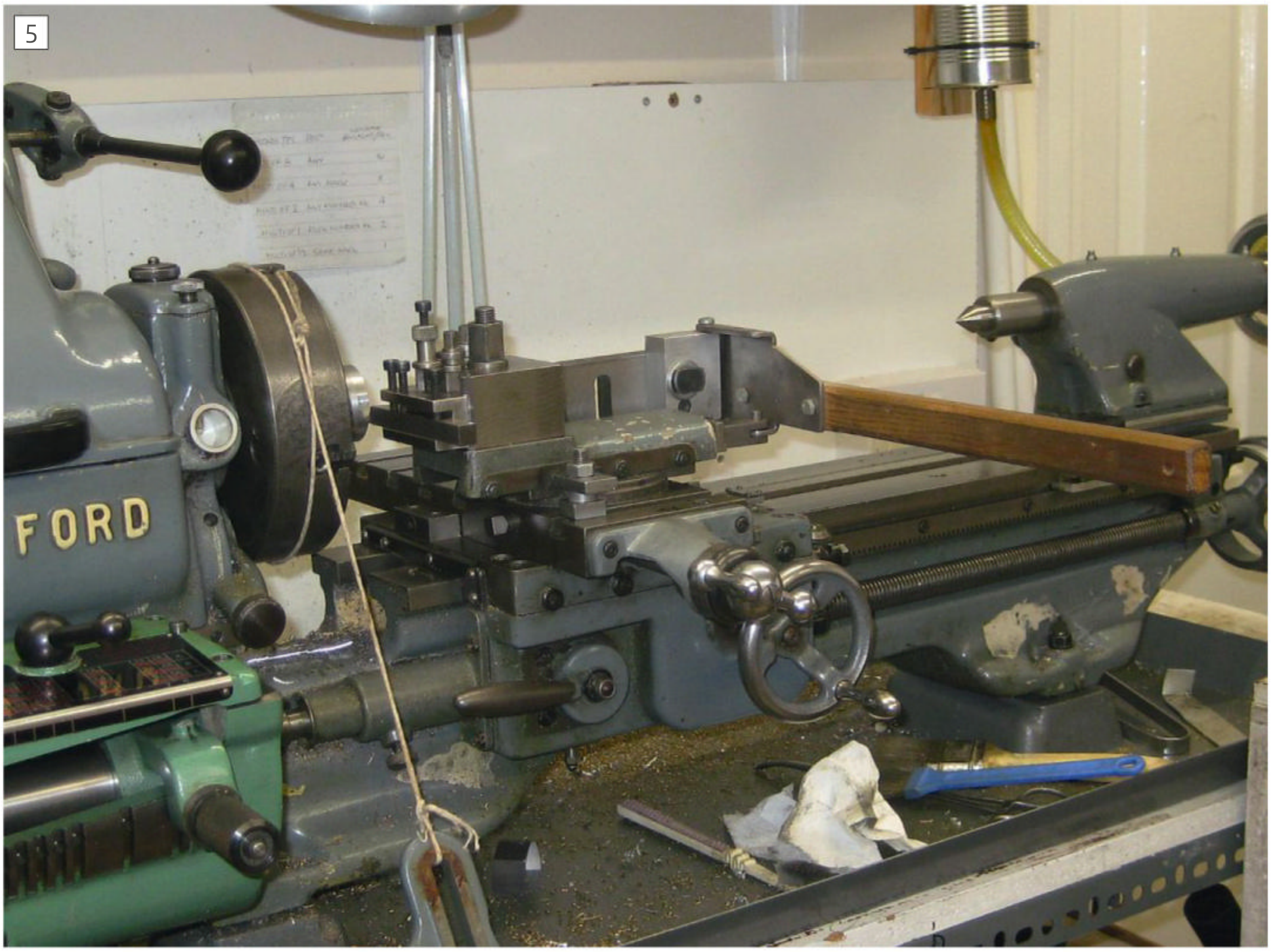
The vernier scale markings need to be spaced so that 10 divisions occupy the same angle as 9 divisions on the Handwheel Dial. This latter has a total of 60 divisions. So:

Angle between adjacent divisions of Handwheel Dial = 360 / 60 = 6 degrees

Angle between 9 divisions of Handwheel Dial = 9 x 6 = 54 degrees

Angle between adjacent divisions of vernier = 54 / 10 = 5.4 degrees

Figure 23 shows a gear train that will allow 5.4 degrees to be indexed and engraved on a Standard Myford ML7 or Super 7 lathe (note that the lathe main spindle is geared 1:1 to the tumbler stud).



Engraving using the Topslide

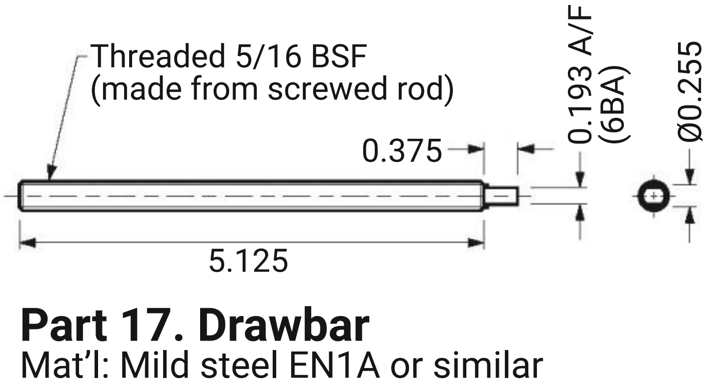


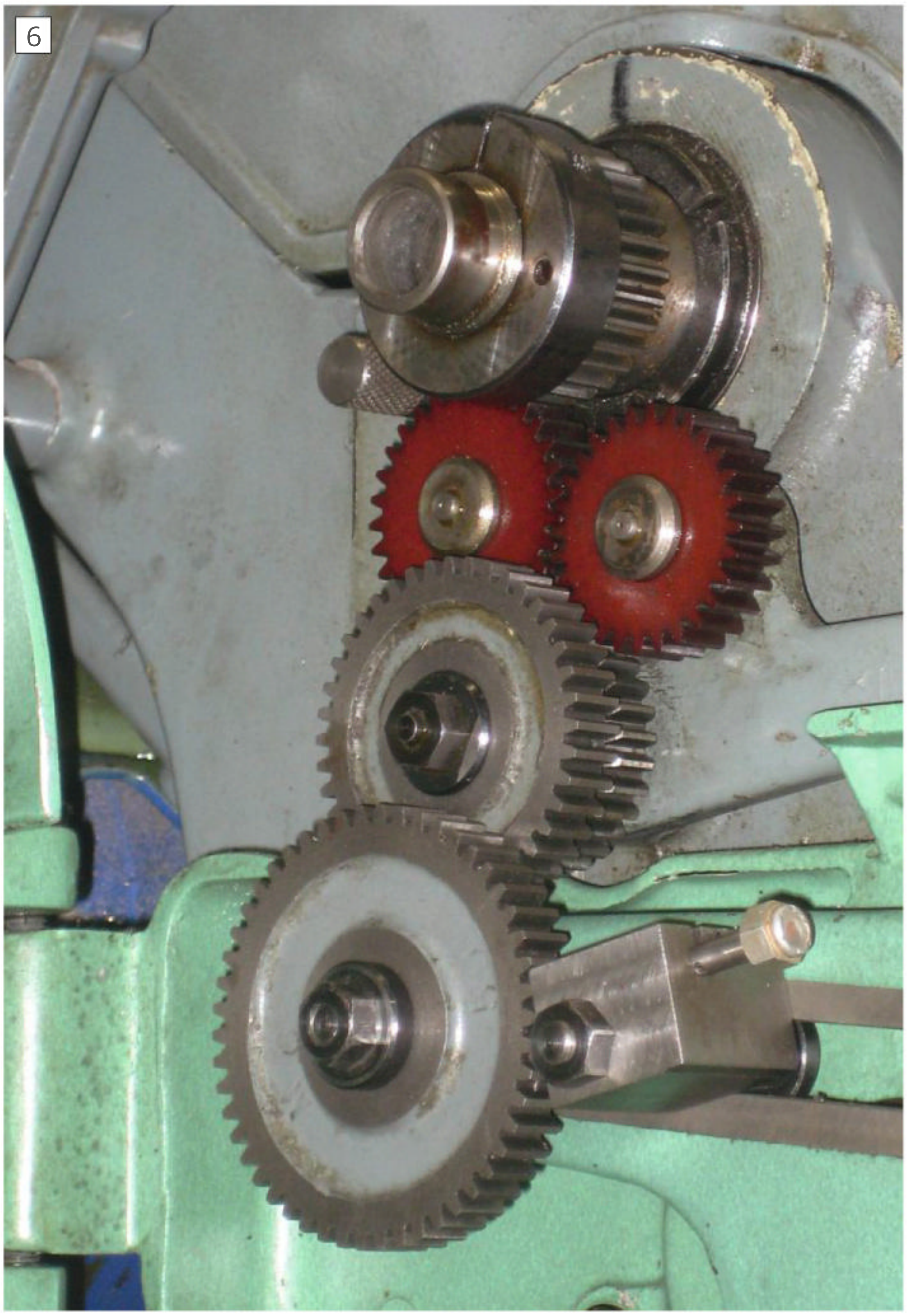
Figure 23

If your Myford lathe is fitted with the Quick Change Gearbox and you do not have the Metric Change Gear Quadrant and the requisite loose change gears another approach is needed. A reduction in the number of vernier scale markings yields 5 divisions that occupy the same angle as 4 divisions on the Handwheel Dial.

Angle between 4 divisions of Handwheel Dial = 4 x 6 = 24 degrees

Angle between adjacent divisions of vernier = 24 / 5 = 4.8 degrees

By a stroke of luck, teeth on a 75-tooth wheel on the tumbler stud can be used to index this spacing directly (360 / 75 = 4.8). You will still need to find a 75-tooth wheel and some means of engaging the tooth spaces and to remove the QCG ›



Gear Train for stepping 5.4 degrees

quadrant. In use you will need to judge equal misalignments for the odd number second decimal places (0.01, 0.03, etc.).

You could also decide to manage without a vernier at all !

If your lathe is not a Myford, the rationale above should help you to work out how to proceed in your case.

The clamps is shown in place in **photo 6.** The remainder of the operations are straightforward.

Note that there are two sets of vernier markings approximately 180 degrees apart.

37 Handwheel Dial Collar

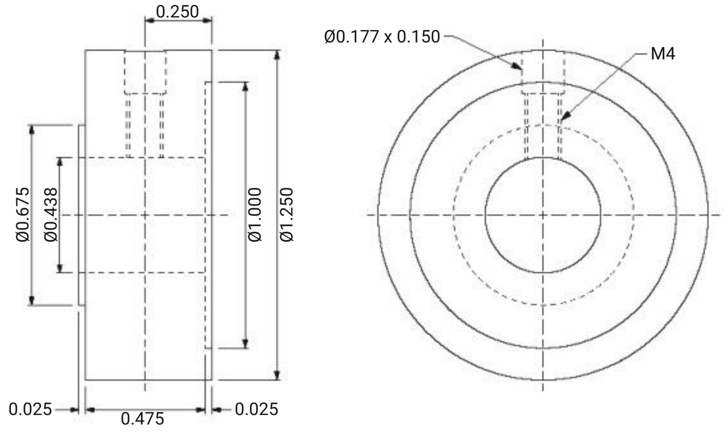
Figure 24. In order to ensure wobble free rotation, the bore and the outer face contacting the Handwheel Dial should be turned at the same setting in the lathe.

36 Handwheel Dial

Figure 25. Again, in order to ensure wobble free rotation, the outside diameter, adjacent short face, shaft bore (which should be a close running fit on the shaft), its adjacent face and the engraved lines should all be machined at the same setting in the lathe. The part can then be parted off, the job reversed in the chuck, parted face machined smooth and the numbers stamped.

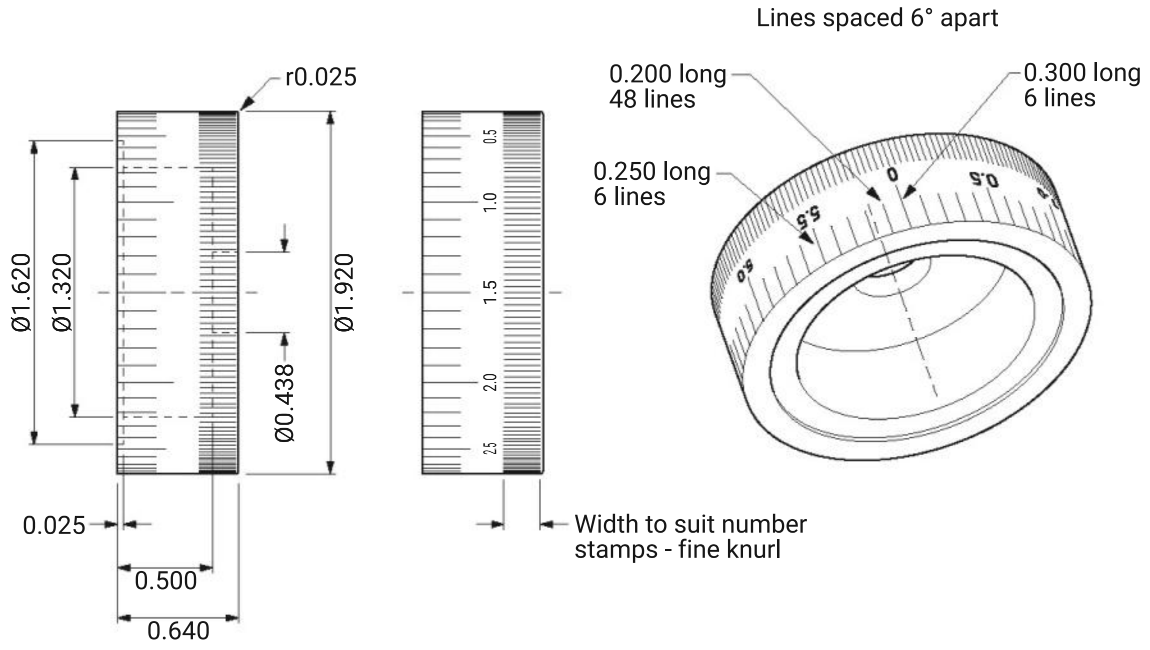
If you have a lathe with a 60-tooth bull wheel (like the Myford Super 7) you can use it with a temporary detent to space out the division lines, **photo 7**. Otherwise you will have to do the same as for the vernier above using a 60 tooth changewheel driven by the tumbler gears as the count wheel.

● To be continued



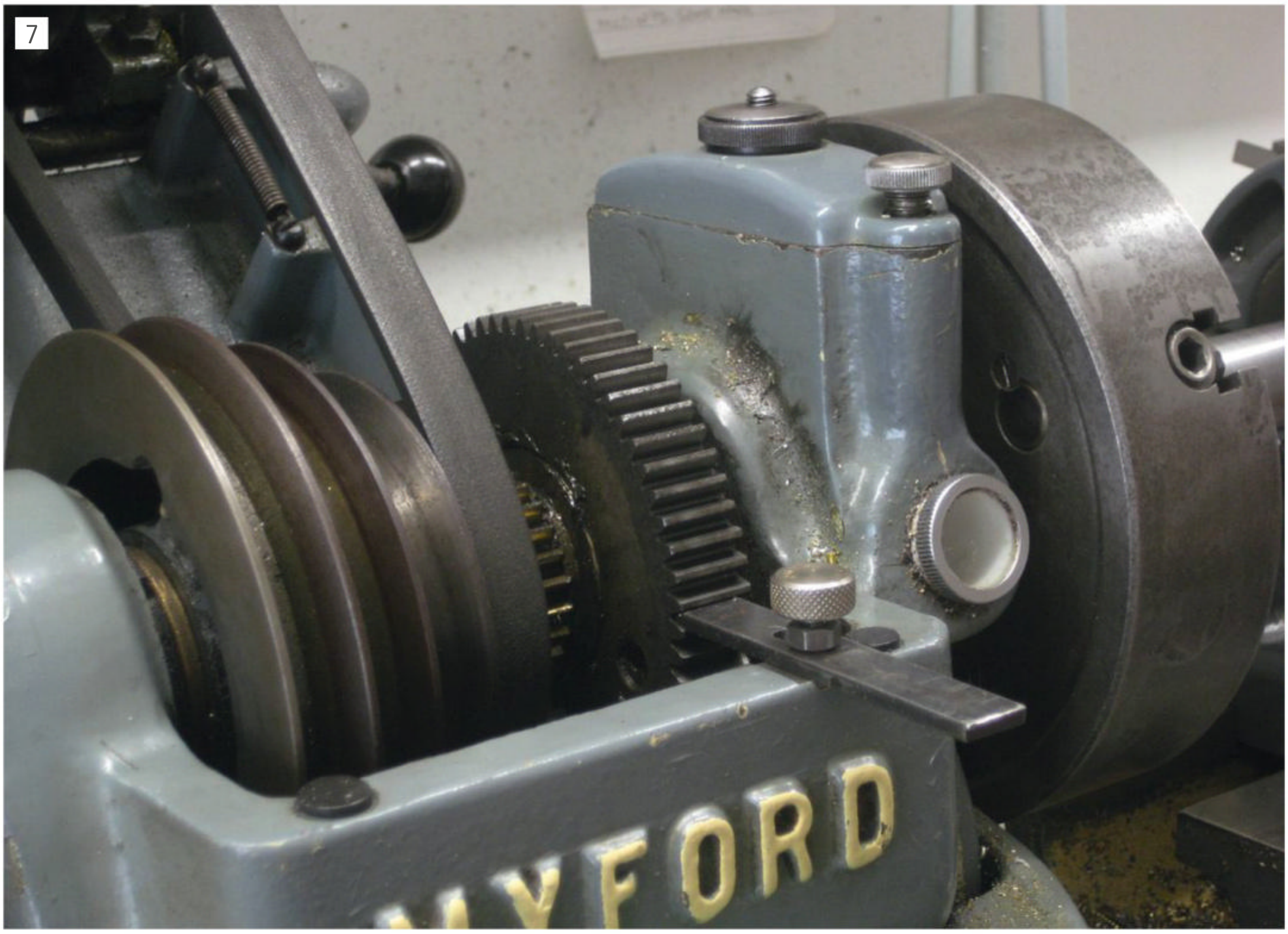
Part 37. Handwheel Collar
Mat'l: Mild steel EN1A or similar

Figure 24



Part 37. Handwheel Dial
Mat'l: 6082T6 or similar forged aluminium alloy

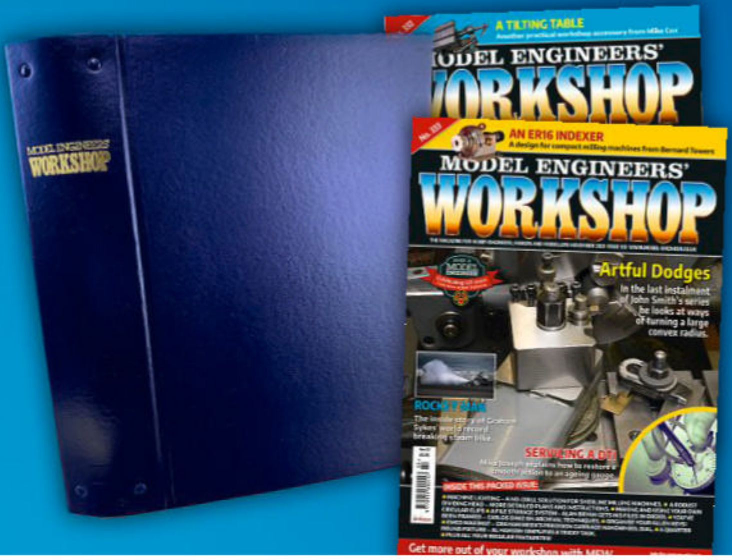
Figure 25



7

Arrangement for stepping 6 degrees

MODEL ENGINEERS' WORKSHOP



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Credits

This index is compiled by Barry Chamberlain. Supplies of Barry's computerised version CAHW are now sold out. For information of alternative computer searchable indexes please visit: www.model-engineer.co.uk/forums/topic/latest-mew-index/

GHT's Universal Pillar Tool

Warren Williams marks fifty years of George H Thomas' Universal Pillar Tool.

Few people having an interest in model engineering will be unaware of the Universal Pillar Tool (UPT) which was designed and first constructed by George H Thomas (GHT). It is likely that hundreds, and perhaps even thousands, of these machines have been built since the design first appeared in a construction series published in Model Engineer in 1974. The UPT has featured extensively in model engineering exhibitions, some examples featuring exquisite workmanship. Approaching the 50th anniversary of the birth of this classic model engineering tool, it seems appropriate to reacquaint ourselves with this still evolving project.

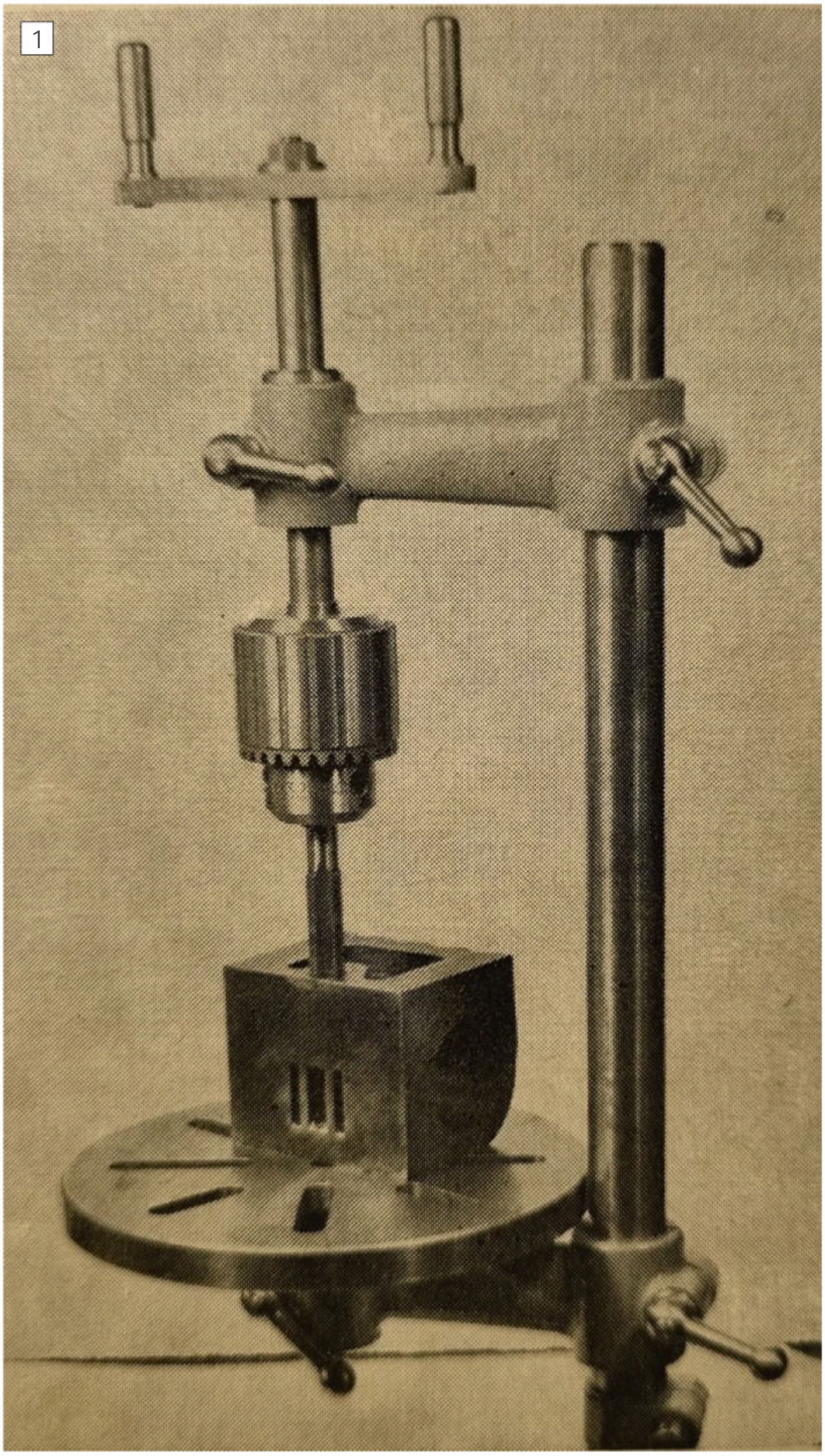
The Historical Perspective

GHT was a prolific designer and builder of tools designed especially for model engineering. Each of his designs thoroughly serves its intended purpose, the fundamental concepts are sound, versatility is a hallmark, the detailing is superb, and the style is classically elegant. A well-executed GHT design is a thing of mechanical beauty.

The UPT was originally called a Tapping and Staking Tool, which indeed it was initially, before extensive subsequent developments by GHT himself, and numerous others were made and are still being made. The tool in its original guise is shown in **photo 1**.

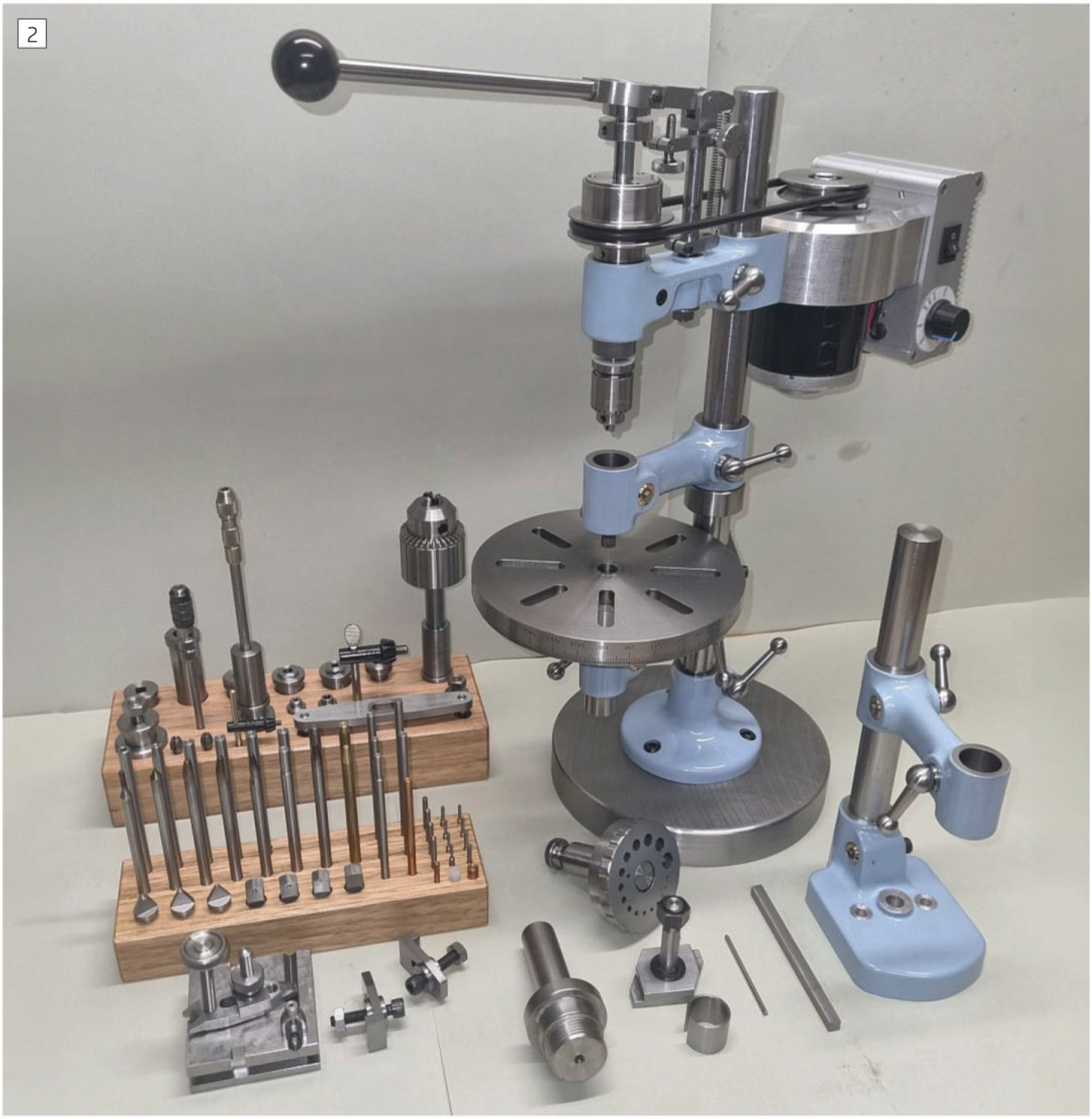
In this series of articles, I give an overview of the history of the UPT, fills in some information gaps in the constructional literature, and corrects errors in same. Finally, some enhancements GHT foreshadowed in his writings, most importantly a self-contained drive for the sensitive drilling attachment, are described. It is not the author's intention to reproduce the entire constructional information. The scope of drawings contained in these articles shall be restricted to documenting new developments.

For a comprehensive description of the UPT in the final form specified by



1

The original tool



Author's UPT with accessories

GHT, the reader should consult the book, Workshop Techniques, **ref.** 1. The three original Model Engineer construction articles comprise **refs 2, 3** and **4** to this article. **References 5** and **6** are subsequent Model Engineer articles about increasing the versatility of the tool as originally described. Reference 1 contains numerous drawings and sketches which, in the aggregate, and read carefully in conjunction with the text and accompanying images, allows a builder to produce a UPT. The book does not, however, contain a complete and consistent set of drawings. The information provided requires some interpretation to successfully complete the project. In the main, the images portray early incarnations of the UPT, and some intermediate evolutionary stages, whereas the drawings and text predominantly describe what might be termed the GHT end-state. In these articles I shall endeavour to clear up some of the inconsistencies and information gaps. A prospective builder would be well advised to thoroughly read the book and to study all the drawings and images before commencing the project. Construction of some parts requires information which appears in a part of the book not directly dealing with those parts. An additional source of information is the various blogs written by builders. A kit of materials, including all castings, is currently available from Hemingway's.

The main parts of the tool comprise the base (largely obscured in photo 1), the pillar, two identical arms, a table,

3

The tap holders

and tap holders. By making the centres of the bores of the two arms accurately to the same dimension (the dimension itself does not greatly matter) and parallel, the axes of a tool held in the upper arm, and a tool held in the lower arm, can be aligned colinearly, to within a high degree of accuracy. This is the fundamental principle of the tool. Investing effort in machining the arms accurately is rewarded with the facility for accurate operation forever after. A less obvious purpose of the tool is to provide the user with what amounts to a steady extra hand, and sometimes two.

In its original guise the main purpose of the tool was to hold a tap square to a workpiece held on the table. Latter developments greatly increased versatility, allowing for a wide range of operations to carried out in association with various attachments. Such operations include riveting, broaching, accurate number and letter stamping, angular graduation with a vernier scale, and drilling very small diameter holes, say No. 80, or about 0.35mm.

The original design was specified in a way that GHT's "lathe only man" could build the UPT using a Myford 7 series lathe, a drill press, and hand tools. This commendable objective, understandable at the time, led to some compromises in construction methods. Some compromises had potential for affecting the accuracy of the UPT, a matter I have endeavored to rectify here.

The author's version of the UPT, complete with all accessories, is illustrated in **photo 2**. This version is made to the GHT end-state drawings although with some improvements. The few deviations from GHT's designs are almost entirely improvements foreshadowed by the master. One change not suggested by GHT is a thicker than standard table. More on that later.

The capacity of the machine as a tapper is geometrically limited to a tap having a 3/8" diameter shank. A coarse thread form of this size, such as BSW, is beyond the limit of torque which can readily be applied on a parallel shank, and also the torque which can be developed using the largest of the three tap holders. A more comfortable tapping limit is fine threads up to say 5/8" (requiring stepped down shanks) and course threads up to say 5/16" BSW. The smallest hole which can be tapped might depend somewhat on the nerve of the user, although from a purely physical perspective, the UPT is ideal for tapping down to 16BA, smaller if the user has such taps. The table diameter of 6" easily accommodates most items within this range and the range of size of items which can be tapped is extended by making use of the alternative alloy base. The three tap holders are shown in **photo 3**. Both of the smaller types have ›

sensitive driving arrangements to help minimise tap breakage.

Typical GHT attention to detail has it that the smallest tap holder is held in a guide with a feature (obscured in photo 3) which prevents the tap holder from dropping down onto the workpiece, possibly breaking the tap, and at the very least obviating an annoyance. A clever feature of the intermediate size tap holder is the large and small knurled driving diameters. The larger diameter allows sufficient torque to be applied for tapping and the smaller diameter allows for rapid reversal of the tap to clear chips during tapping and for withdrawal after the hole is tapped.

Because the main interface of the arms, pillar, and attachments is either an accurately machined 3/4'' or 7/8'' diameter hole, the machine can be assembled in a variety of ways to optimally suit the operation being performed. photo 1 shows the pillar set in the base, which suits drilling and tapping. In **photo 4** the machine is set up for riveting and the lower rivet snap is set in the base, with the pillar supported by the lower arm, from which to carry the top arm, allowing the top rivet snap to be easily aligned with the lower snap. The top rivet snap holder has a similar controlled friction feature, referred to above in connection with tapping, to hold the snap in space, so it is prevented from inadvertently dropping onto the workpiece when the user is setting a rivet in its hole. The relatively heavy riveting force is carried directly into the base of the machine, rather than overloading and potentially breaking the lower arm, which would occur if the setup shown in photo 1 was used. **Photograph 4** shows the UPT base attached to a heavy disc of 25mm ground steel plate which substantially improves energy absorption during any operation involving impact and also vibration when using the sensitive drilling attachment.

An alternative base, referred to by

4

UPT set up for heavy work

GHT as the alloy base, and short pillar, shown in the lower right corner of photo 2, allow the full capabilities of the UPT to be conveniently taken to the lathe bed, or cross slide, or to the milling machine table, thereby increasing the versatility of those machines and the UPT itself.

Evolutionary developments of the UPT fall under two headings, improving ease of construction, and increasing the range of tasks the UPT can perform. The most important development in respect of the former was to change the clamping arrangement for the bores of the arms and the base onto the pillar. GHT originally specified what he calls a "slit it and nip it" design, which he subsequently replaced with a pad bolt. The original style is shown in the images in ref. 1 however the drawings and text reflect the superior pad bolt design. The original style is probably easier to make however a bored hole almost always closes in after being slit, thereby damaging the most critical feature of the design, and a introducing a fault that is very difficult to entirely correct. photo 1 shows the original design and photo 4, the latter. The clamping surfaces of the pads in the pad bolt design should contact the pillar conformally, a result best achieved by machining the radius which mates with the pillar at the same time the associated bore is machined. This exercise requires some planning to correctly sequence the machining operations, something not described in much detail in ref. 1.

GHT decided to graduate the table after the table had been designed which led to some difficult squeezing-in of the graduations and numbers. An improved, thicker, table design which obviates this problem will be shown in a subsequent article. The pillar subsequently had a keyway added and this required one of the arms to be modified to carry a key to engage the keyway, a feature which is probably most sought after by clock makers, and which I have not implemented. Not everyone enjoys making ball handles and GHT suggested commercially available alternatives. Nothing however compares with the ball handles for appearance and feel. Other developments were mostly attachments, most notably the sensitive drilling attachment, also the rotatable stake, offset stake (for riveting near to edges), a clock-plate bushing tool, and miscellaneous tooling. No doubt many users have customized their UPT with other attachments and modifications to suit their own particular needs.

The original UPT had the motor for the sensitive drilling attachment mounted on a base board, driving the spindle using a belt carried over jockey pulleys mounted on the rear of the drill arm. The drive shown in photo 2 is a 24 Volt DC variable speed drive. This new style of drive can be easily retrofitted to a UPT made to the original design.

We might ponder what GHT might have made of developments in model engineering over the half century following his UPT creation? The changes are probably most pronounced in equipment the modern amateur takes for granted. GHT would undoubtedly have approved of DRO (Digital Readout) in the home workshop for improved accuracy of various operations one suspects. With DRO, many of us now have in our home workshops nearly the accuracy of the most accurate professional pre-DRO machine, the jig borer, a highly specialised first-class toolroom machine virtually no amateur could have afforded. What of carbide cutting tools? GHT expressed his views on this subject (ref. 8, page 286), concluding there was limited scope for tungsten carbide tooling in the model engineer's workshop, owing to difficulty of proper sharpening, inadequate spindle speeds, and poor performance on intermittent cuts. Replaceable tip tools, unknown then, address two of those objections, and the advent of variable speed machine tool drives somewhat counters the speed argument.

GHT advocated strongly for Loctite rather than interference fits although why is not evident, especially given his emphasis on precise, well-finished, work. Although convenient and forgiving, a joint made with adhesive material requires clearance between mating parts, and fluid cannot be relied on to accurately centralise those parts during the curing process (a common misconception - most such retainers work best with a force fit – Ed.). I prefer the traditional interference fit, which with a little care, is not unduly difficult to make, and results in perfect alignment. The last fifty years have not all been good news for the home workshop worker. Although there has long been an established supply chain for engineering tools aimed primarily at the amateur, the more sophisticated and higher quality tools used by the amateur have typically come from suppliers whose main focus was the professional. Professional workshops do very little hand work these days, CNC (Computer Numerical Control) now being common in even small workshops, even for jobbing work. The consequently greatly reduced demand for professional hand tools, high quality files for example, means recreating a workshop equipped as splendidly as that of GHT is now rather difficult, if not impossible.

In the next article, errors and information missing from the construction information will be addressed, also an improved method for machining the arms. The author has no interest in any of the firms mentioned in any of the articles in this series.

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8 The Model Engineers Workshop Manual, Geo. H. Thomas, TEE Publishing, 1992

● **To be continued**

A Split (into two pieces) Die

Laurie Leonard hopes that he will prevent others from making a similar costly mistake.

I was engaged in what started out as a straightforward threading operation on a piece of 6mm diameter mild steel rod. It was not a high tolerance job but an incidental task on a bigger project. The threading was started holding the rod in the lathe, more on this later, to get reasonable concentricity, followed by gripping it in the vice and transferring the die to a die stock. As threading progressed the torque on the die started to cause the rod to slip in the vice: a quick nip up on the vice jaws then - Crack! The job then seemed to free up a bit. So what had happened and why?

Split Dies

I always purchase split dies as these enable a certain amount of adjustment on the fit of the thread. **Photograph 1** shows a split die taken from what would appear to be an odd angle. This was intentional so that the split was clearly visible together with the lead chamfer to the split and the two recesses for the locating screws. A basic die with no split is shown in **photo 2.**

Photograph 3 shows a (the!) split die in a diestock. In use, the centre screw is adjusted inwards to open the die which makes for a larger thread outside diameter (OD). This can be backed off later and a fresh cut taken to slightly decrease the OD if required and make a freer turning thread. The complete breakage occurred, **photos 4** and **5**, because I had not completed the next step properly. Once the centre screw has been set the other two screws are tightened to lock the die. I had not tightened one of the screws and the action of cutting the thread was such that it tried to open the die which it did resulting in the breakage. Interestingly when the screw

A split die.

A basic die with no split.

3

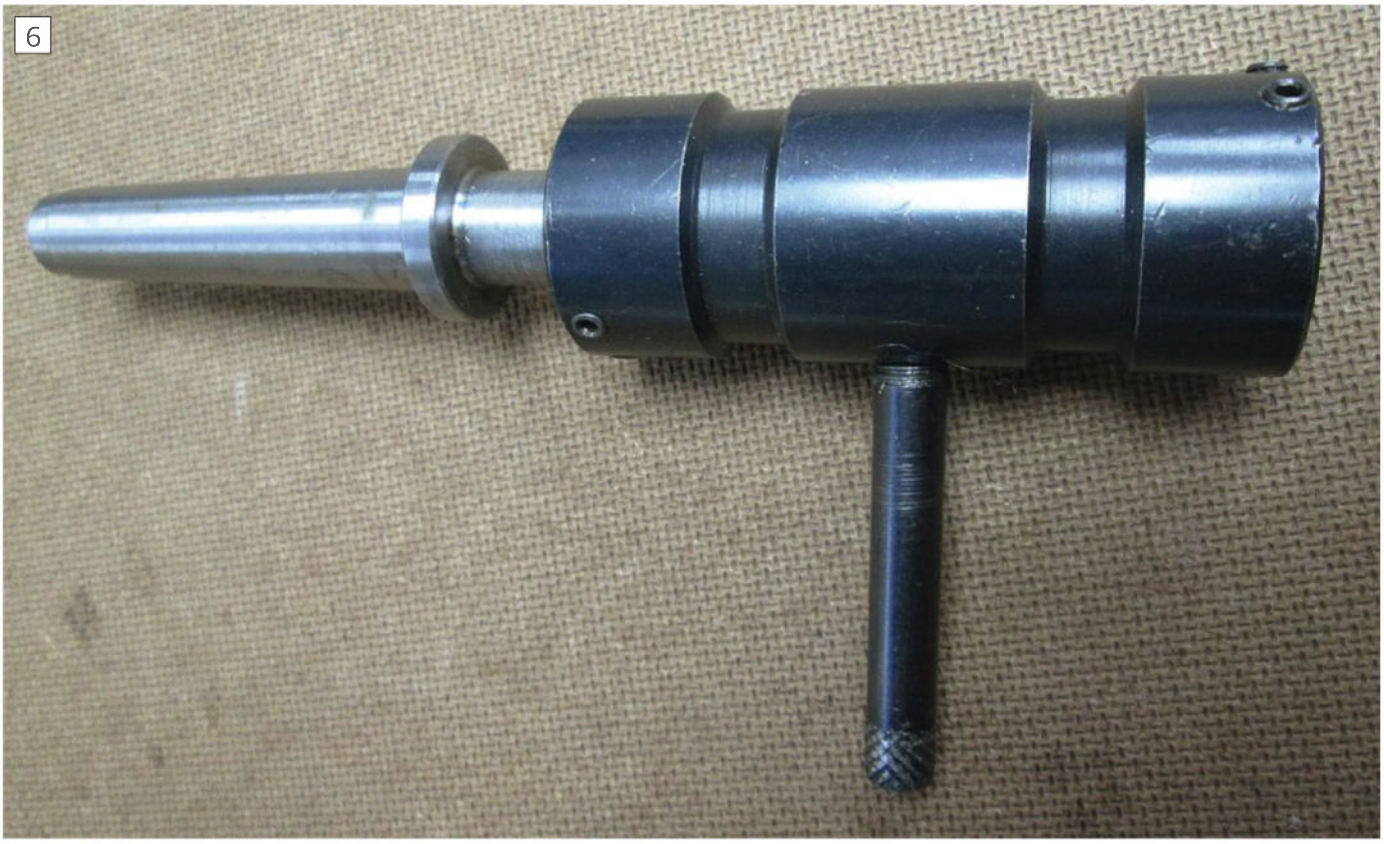
A (the) split die in a die stock.

4

Broken die.

5

Another view of the completely split die.



6

Purchased lathe die holder set.

7

Another view of the holder.

8

Shop made sleeve to suit own dies.

9

Scoring on mandrel surface with use.

was tightened the die, completely split, continued to cut and the job was completed. The die has since been replaced hence the cost.

Lathe Die Holders

As an aid to concentricity I had purchased a lathe die holder set, **Photographs 6** and **7**, which for my lathe comprised a Morse Taper 2 (MT2) mandrel with a parallel portion on which slid a sleeve into which the relevant die was fitted as in a die

Table 1 – Comparison of die/stock diameters

Die OD Size	Imperial (inches) Nominal	Metric (mm) Nominal	My Set Measured (inches)
	0.5	15	
	0.75	20	20.68 (13/16?)
	1	25	25.5 (1)
	1.5	40	38.3 (1.5?)
	2	50	
Tailstock Holder ID Size mm	**Purchased Set**	**Shop Made**	
	20.75	20.1	
	25.44	25.3	
	33.26		
	38.13		

stock. The sleeve and additions were sized to accommodate various OD dies. In my ignorance I thought these were standard sizes and the first time I used it I was far from happy with the clearance around the die. Some clearance is needed for the adjustment mentioned above but this was excessive, so I made some shims. Much later I discovered that there appears to be standard sizes but at least two sets: imperial and metric. I then spent a lot of time on the internet and with books trying to find these sizes defined. **Table 1** shows the best I could discover and perhaps the Editor or a reader could enlighten me with the definitive dimensions (not checked the British Standard series yet as I do not currently have access).

I ended up making my own sleeve to suit my dies, **photo 8**.

In operation the sleeve moves along and around the mandrel. I have always been conscious of swarf getting into the slight clearance between sleeve and mandrel and taken steps to lubricate and clean the mandrel and sleeves but my mandrel would appear not to have been hardened and the swarf that has got in has taken its toll on the mandrel surface, **photo 9**.

Conclusion

A short lapse in setting up the die resulted in a breakage and subsequent expenditure but so far, I have learnt from it and not done it again. ▮

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John Arrowsmith reports from the society's AGM held at the Bedford Model Engineering Society.

Barbados Railway
Paul Stone takes a ride with a rum ration on the Barbados heritage railway.

Angle Plate
Mike Joseph adds a small and very useful angle plate to his workshop equipment.

Hercules
Chris Walter builds a twin compound marine engine based on a design published in Model Engineer 100 years ago.

LNER B1
Doug Hewson details the cab fittings for his 5-inch gauge LNER B1 locomotive.

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SMEE NEWS

An update from the Society of Model and Experimental Engineers

For SMEE 2023 has been a busy year, as we celebrate the 125th Anniversary of the society's founding in 1898 by Percival Marshall. The last couple of months have been particularly active arranging exhibits for Forncett Industrial Steam Museum's model engineering day and the MMEX show preparations in addition to all our regular meetings and activities. Perhaps more of that at a later date, but for now here is just a snippet from the recent talk at the Society's monthly General meeting held at Marshall House and on Zoom by SMEE member Rich Carlstedt from Green Bay, Wisconsin.

Rich described his research into Mathew Murray, less well-known than his great rivals Boulton and Watt, and this, with a detailed inspection of the engine at the Ford Museum led Rich to build a fully operation model of of Murray's cycloidal engine to an exceptional high standard.

Rich delivered a highly entertaining and informative talk covering the history and innovation of Mathew Murray and the Round Foundry and the hostility of Boulton and Watt towards his work. Following on from this Rich took us on a detailed 'trip' round the model engine, pointing out the reasons for many aspects of Murray's design giving great insight into the mind of Murray as an engineer. The discussion of the model coupled with explanations of how Rich produced many of the parts to accurately replicate the original was particularly useful. It also became clear how much attention Murray paid to building an engine that was was easy to maintain and repair, with parts subject to wear or even breakage being easily replaceable and so reducing downtime to a minimum.

As a society, SMEE has enjoyed a spin off benefit from the Covid restrictions by prompting us to develop the use of Zoom for meetings. This allows us to have live interaction with members as far flung as California, South Africa, Slovenia and the whole of the UK and gives them the ability to share their knowledge and delight in their interests from their own homes.

For more information on SMEE browse www.sm-ee.co.uk

For the engine see www.thehenryford.org/collections-and-research/digital-collections/artifact/185106#slide=gs-187880

For Forncett see www.forncettsteammuseum.co.uk

Retracting Tool Holder

Dear Neil. I am attempting to build the retracting tool holder described in MEW 328 and 329. I wonder if it would be possible to pass on a couple of questions to the author?

1 What is the vertical dimension of the bottom slot in the "Bed Clamp Body"?

2 I can't understand how the "Latch Operating Ramp" and its associated parts fit together. What stops the "Latch Operating Ramp Holder" from rotating about the hold down screw?

Chris Bell, by email.

What do readers want to see in the pages of MEW?

Dear Neil, I looked at Model Engineering Workshop edition 333 today and was somewhat confused as to whether I was reading and engineering magazine or one for Do it Yourself (DIY).

There were five pages including photographs of a wooden base to store metal files. Any schoolboy with a bit of common sense could make such a thing, many sililar things are made to hold drills etc.

I presume these people get paid for their entries in magazine but I am surprised that room for such things are published in a prestigious magazine.

It looks as though you are trying a different approach, I would suggest that you stick to engineering especially for the newcomer or those possible engineers of the future.

John Eley, by email.

Hi John, Thanks for your thoughts. It's not realistic to expect that every article in every issue will appeal to every reader. I hope Issue 333 was well-balanced with other articles on core engineering topics such as a dividing head, indexer, servicing DTIs, a machine light, and an accurate saddle feed.

The file holder article isn't really about the file holder itself. It's about how to go through a process of design and the ways you can use 3D CAD to help with this. Many people find CAD intimidating, so the application of a complex approach to a simple subject is useful to them.

I am always open to feedback from readers and I'd be pleased to get more letters about what people want to see in the magazine (and, of course, more articles submitted on such topics!)

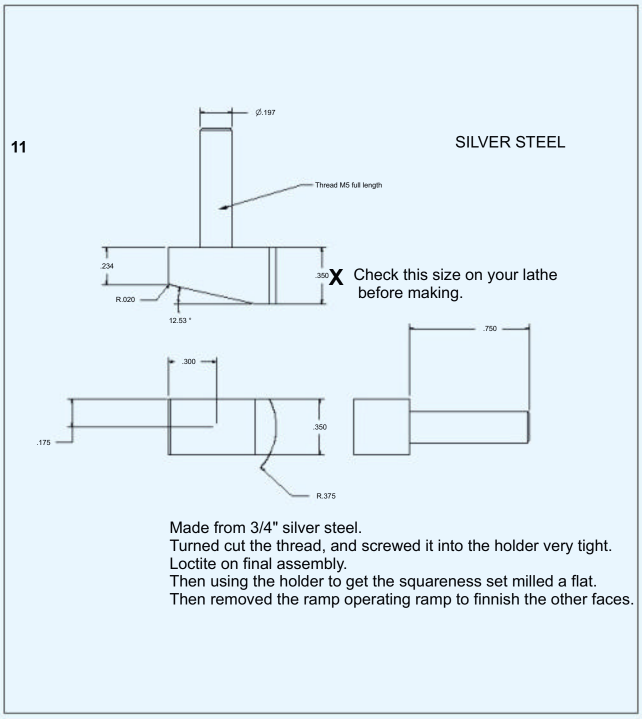
Neil Wyatt, Editor

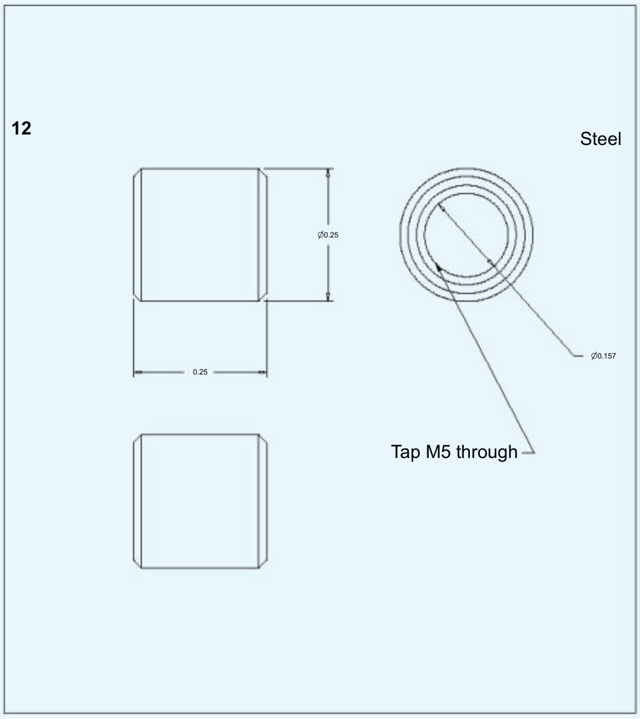
David George Replies

Hi Chris, I have just had a look at the drawing of the body and I attach a copy with two dimensions which were missing. When I made the clamp ramp little piece it was made from a piece of ¾" round silver steel which was screwed and Loctite fixed as well. It was machined in situ and the height was checked by using an adjustable parallel to check the height. The holder was set on the lathe on tool centre height and I moved the height of the parallel on the clamp body till it tripped the latch and added 0.015" just to be safe.

I have redrawn the latch ramp drawing to make sure it cannot rotate, although I have had no problems, but I have extended the thread length of the latch ramp piece and added a small round nut to slide in the slot. I hope this makes sense and thanks for helping me to design this better.

David George, by email.





The 2023 Midlands Model Engineering Exhibition

Neil Wyatt spent four days at this year's MMEX at the Warwickshire Event Centre

The highly successful 44th Midlands Model Engineering Exhibition took place from Thursday 12th to Sunday 15th October 2023 at the Warwickshire Event Centre, with thousands of visitors in attendance, **photos 1** and **2**.

The Society of Model and Experimental Engineers and Model Engineer/Model Engineers Workshop celebrated their 125th joint anniversary at the exhibition, **photo 3** and **4**. There was also a number of other special attractions this year including the lecture programme, special exhibit displays and the reintroduction of live demonstrations.

The exhibition showcased hundreds of fascinating models in competition and display classes

Visitors at the Polly Engineering stand.

REMAP, whose volunteer engineers help disabled people with bespoke devices had a stand.

and on the club and society display stands, **photos 5** and **6**. The winner of the overall best model in the exhibition and the *Chris Deith Memorial Trophy* was Mike Sayers with his 1927 Delage 15.S.8 GP engine.

Model Engineering clubs and societies were well represented with some 30 stands with hundreds of quality exhibits on display. The best *Society Display* winners were:

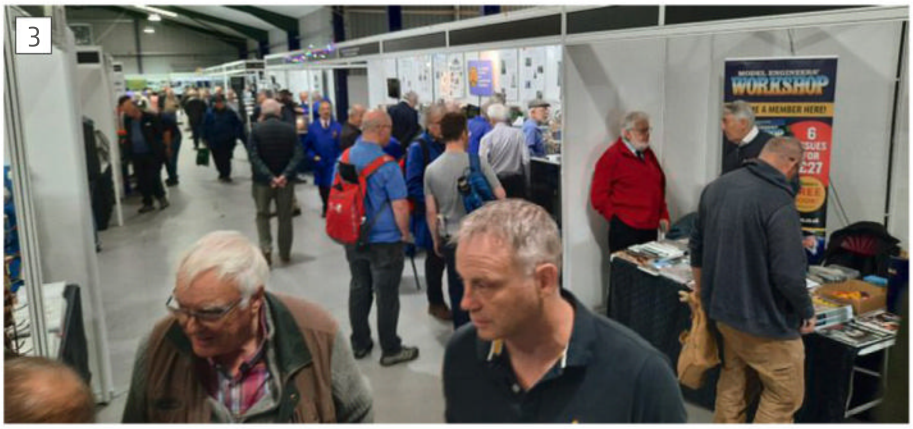
1st Coventry Model Engineering Society
2nd Hereford Society of Model Engineers
3rd Society of Model & Experimental Engineers

Outside attractions included the Fosse Way Steamers, **photo 7,** where a wide selection of live steam scale model engines were in action for the enjoyment of thousands of visitors.

2024 dates for your diary are Thursday 17th to Sunday 20th October again at the Warwickshire Event Centre.

Tooling at MMEX

For some reason, hobbyists are often rather slow to share their home-built tooling at model engineering shows. Perhaps this is because such items are often built for practical use rather than as display items, so they can appear utilitarian or even 'agricultural'.



The Mortons stand was next to the SMEE, the K1 Max 3D printer is just visible in the centre.

Ironically, such items are often of as much interest to the average hobbyist as the spectacular working scale models. Fortunately we found some interesting tooling at the show to share with readers.

The Hereford Society of Model Engineers put a lot of effort into supporting young engineers and have helped several of them to secure apprenticeships with local firms. The stand had some well-made examples of their work, **photo 8** and **9**. There was also an excellent and very nice

Demonstrating gear cutting on the SMEE stand.

Model LNER P2 Cock O'the North.

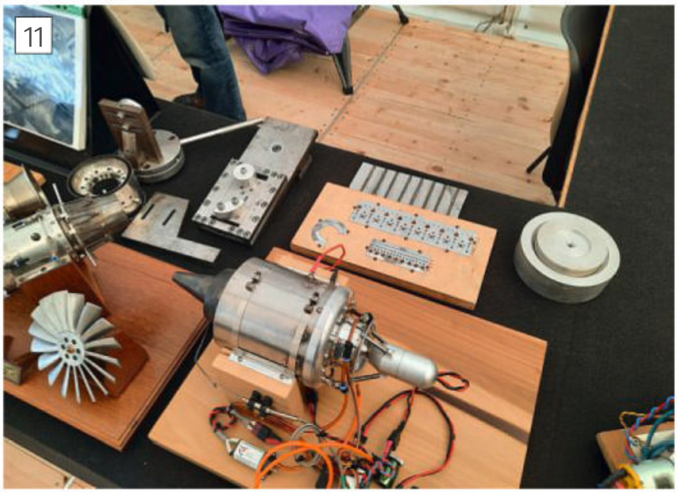
Model BSA Gold Star.

Live steam traction engine model.

Tools made by young members of the Herefordshire Society of Model Engineers.

More of their tooling, plus a 3D printed flywheel pattern.

A robust drill sharpening jig.



The Gas Turbine Builders' Association.

sharpening jig for larger drills on the stand, which was demonstrated to me by its maker, Wally Sykes, **photo 10.**

The Gas Turbine Builders Association displayed a range of tooling used in building their jet engines, **photo 11**. Much of the work involved sheet metal forming, and also a lot of manual milling – using jigs rather than CNC, much to the surprise of many people.

There was also a popular display by the Society of Ornamental Turners, featuring the complex multi-geared chucks for creating astonishing decorative patterns, **photo 12**.

No show is complete without a Quorn Tool and Cutter Grinder (designed by Professor Dennis Chaddock), **photo 13** shows Allen Berman's fine example on the SMEE stand. Also on the SMEE stand was a case with a selection of smaller tooling for various purposes including a ball turning tool and a nice fingerplate by Grham Nickson, as well as an unusual sculptural artwork, 'Urchin' by Mary Crabb, made from woven copper, **photo 14**.

The Coventry Model Engineering Society displayed a robust raising block for elevating the vertical spindle on a Centec 2b milling machine by around 100mm, **photo 15,** shown next to a gauge 1 Collet Mogul. **Photograph 16** shows a well-finished Kennet tool and cutter grinder on the Coventry MES stand. Also on their stand was a nicely cased knurling tool made to a design featured in MEW issue 72, **photo 17**.

The show did have a good attendance by sellers of tooling and accessories, although those selling

The Society of Ornamental Turners.

complete machine tools were thin on the ground. However, as has been the case in recent years Myford attended and had some of the very limited supply of their new (not refurbished) machines – a brace of Super 7 lathes, **photo 18**. It's hard not to think that a company selling entry level machines could do a brisk trade at such a show, with no direct competition.

On the tooling and accessories side, plenty of familiar faces were present including JB Cutting Tools and Home and Workshop Machinery, **photo 19**. There were also several stands specialising in used items, The Engineers' Emporium and LA Services featured a treasure trove of interesting objects, **photo 20.**

Quorn tool and cutter grinder.

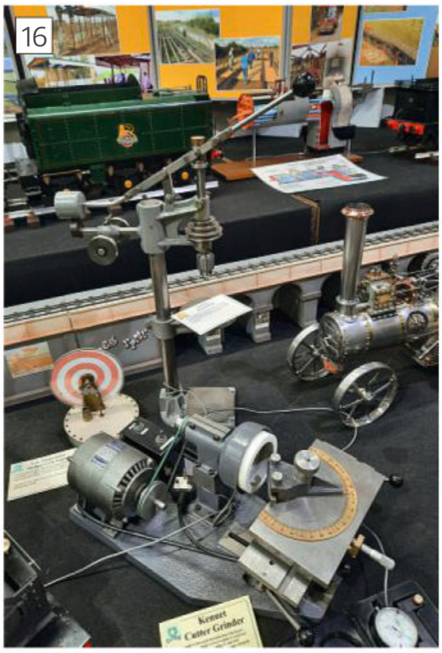
Assorted small items on the SMEE stand.

Model Engineers' Laser were exhibiting a wider range of laser cut products, **photo 21**, including some interesting sets of small spanners suitable form working in awkward spaces, **photo 22**, (you can bend them to reach deep inside locomotive frames, for example!)

Two Mystery Tools

Thanks to Alan Hopwood of the SMEE for showing us two intriguing tools. The first, **photo 23**, is a tiny and apparently shop-made, internal and external caliper. Ungraduated it is probably intended for use as a comparator. Despite the patina it works beautifully smoothly. The second item, **photos 24** and **25** is more of a mystery, obviously some sort of clamp it clearly has a special purpose. Clues are the hollow handle and other features visible in the photos which lead to a presumed solution for the device. If you think you know what it is, drop us an email.

Raising block for Centec Mill.

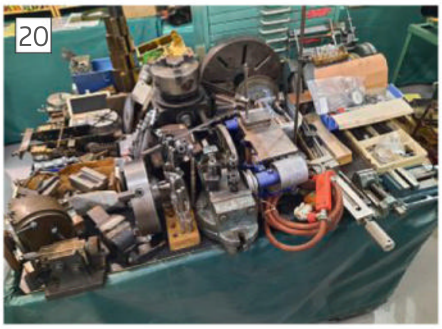


Kennet tool and cutter grinder.

Knurling tool to an MEW design.

New Myford Super 7 lathes.

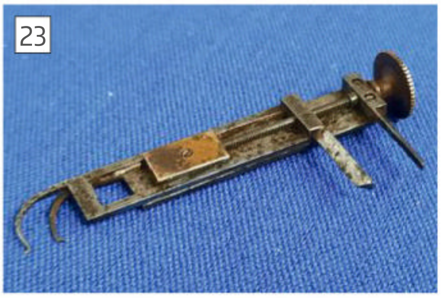
One of many busy trade stands.



An Aladdin's cave of tooling!

Model Engineers' Laser.

Laser cut spanner sets.



Hand made and very delicate precision caliper.

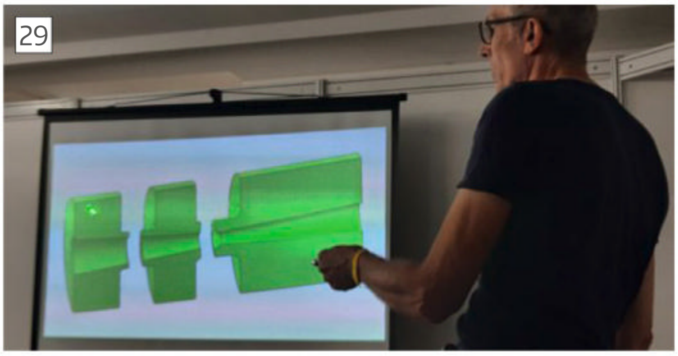
Mystery clamp tool note the hole in the screw.

Hole in handle of mystery clamp.

Martin Evans, editor of Model Engineer debating the capabilities of the Creality K1 Max.

Unfortunately I didn't get good pictures of the 3D printers in action.

Attendance at the MEW Lectures was excellent.



Roger Froud explained his injector design.

Stewart Hart brought along several of his steam engine models.

Chris Gabel's powder coating made for a colourful subject!

The Model Engineers Workshop Talks

Martin Evans, editor of Model Engineer and I (Neil Wyatt) enjoyed meeting many, many readers at the Mortons stand and the SMEE stand, where I was demonstrating two 3D printers, the Creality Mage Pro and the Creality K1 Max, **photos 26** and **27.** The quality of the Mage Pro prints astounded people, but they were also amazed by the rate at which the K1 Max was working – I had planned to focus on engineering objects, but in the end the Tyrannosaur skull attracted far more attention (kids were much better than adults at identifying it!) Unfortunately I didn't get any really good photos, but I will be featuring the K1 in an upcoming article.

I'd particularly like to thank Roger Froud, Stewart Hart, Duncan Webster, Roger Backhouse, Chris Gabel and Bob Reeve for their excellent talks, **photos 28, 29, 30** and **31**. Attendance at the talks was much more than our expectations. Unfortunately we had some problems with sound that were only partly resolved by the end of the exhibition, it was noisy and the room had a lot of echo, limiting how loud we could have the PA without feedback. Stewart in particular was affected on Friday morning, which was the busiest time and the background noise was loudest. Next year there will be a larger room with better soundproofing, and I will get hold of a clip microphone.

All in all the exhibition was a learning experience for me. I had to pull the AV setup for the talks together from my own equipment and it hadn't been used this way before. Also it was difficult to tend two 23D printers and organise three talks a day while also finding time to speak to as many readers as possible, while still trying to get to see as much as possible of the exhibition. Nonetheless, it was a very reward four days. ■

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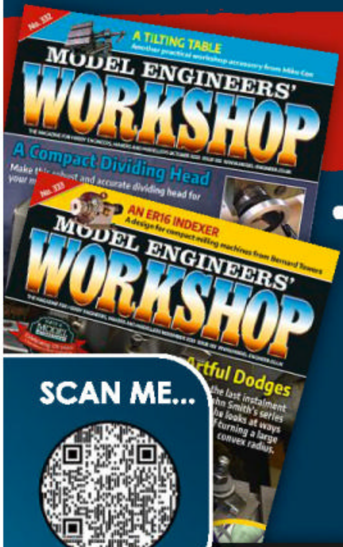

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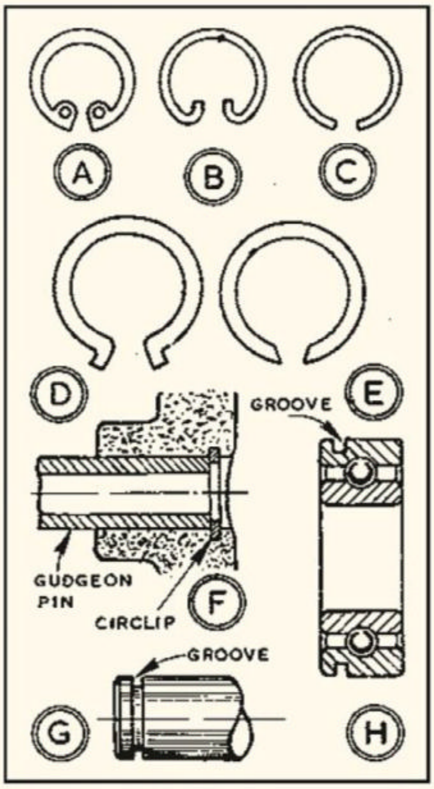
BEGINNERS WORKSHOP
These articles by Geometer (Ian Bradley) were written about half a century ago. While they contain much good advice, they also contain references to things that may be out of date or describe practices or materials that we would not use today either because much better ways are available of for safety reasons. These articles are offered for their historic interest and because they may inspire more modern approaches as well as reminding us how our hobby was practiced in the past.

Beginner's Workshop

CIRCLIPS

GEOMETER details the removing and fitting of some modern locating devices



NOT SO MANY years ago a circlip as a locating device was something of a rarity, not inspiring full confidence in engineers. Some thought it likely to work loose or jump out of its groove in use, to break from vibration, or soften or distort when subjected to heat-with more or less disastrous results.

Some circlips did, in fact, give trouble-from wrong material, wrong application or fitting. But modem examples are among the simplest and most reliable locating devices, if a few simple rules are followed.

Circlips, like split pins, are advisedly regarded as expendable items and used only once. Where side thrust is likely to be encountered; they should be of rectangular section, seating properly in accurate square-sided grooves. Round section types in half-round grooves may compress or expand (depending on the application) and push out. Such circlips should always be sunk in their grooves to at least half the diameter of their section. With circlips of soft material, which have to be squeezed into grooves, care must be taken to do this properly.

Common types

Popular types of internal and external circlips are shown at A to E. Type *A* is of rectangular section to fit a square-sided groove in a bore, and is provided with two holes for compressing with a suitable tool when fitting or extracting. Type *B* is also for a bore, and of round wire with the ends turned in for manipulating with narrow-jawed pliers. Type C is of round wire and may be fitted in a bore or on a shaft-sprung in or on, and levered and pushed out with a screwdriver blade. All these are hardened and tempered and, consequently, springy.

Type *D* for external fitting is soft, however, and of rectangular section provided with lugs at the ends for squeezing it into its groove. Type *E* is also rectangular section, but springy, and for external fitting-Its ends being chamfered inwards to permit of easy levering out.

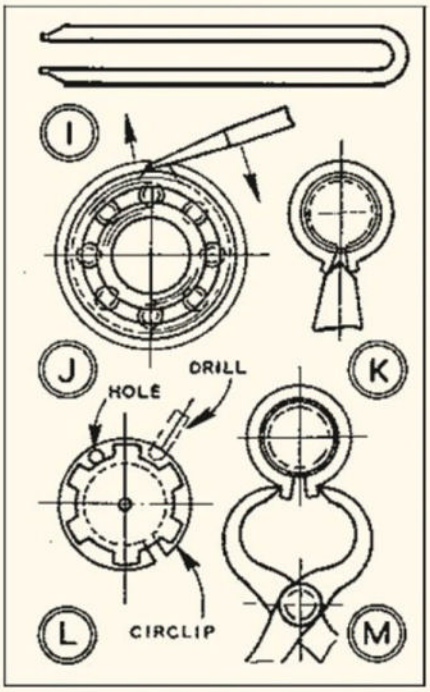
Common uses for type *A* circlip are for end-locating gudgeon pins in pistons, *F*, and for similarly locating bushes in needle roller universal joints. The circlip should only be used once, and great care exercised to seat it properly. Type *D* circlip fits in a groove, G, and is often used for car brake shoe pivots. Type *E* circlip is employed where a ball race, H, carries a groove in its outer member, the circlip then locating it endwise in the housing.

Piston circlips can be manipulated with small round-nosed pliers or a tool, Z, with reduced diameters at the ends to fit in the circlip holes. Full compression and square extraction from the bore are necessary, since accuracy of fitting is such that the circlip cannot be withdrawn aslant.

The ball race circlip can be removed as *J*, using a screwdriver blade under one of the ends, lifting out an sideways placing another screwdriver behind and working right round. For brake shoe pivot circlips, blunt-ended punch or chisel *K*,, can be used for opening and freeing, and the ends of the circlip tapped with a hammer as if to drive it over the diameter. Then with the circlip loose, it is usually possible to enter a small punch or screwdriver at the back opposite the lugs, and so lever the circlip off.

A stout circlip or locking ring on a splined shaft can prove very difficult to remove. An easy way, however, unless the material is hard, is to drill a hole from the side or above and away from the ends to weaken the circlip, L, until the ends can be levered open with a screwdriver or a blunt chisel used (as K). Careful cutting with a small chisel from the side and above will weaken a circlip.

Fitting of circlips is usually straightforward, taking care they are seating correctly, though the soft type, *D*, is best squeezed with large pliers or ordinary pincers, M.



A Metalwork File Storage System, Part 2

Alan Bryan breaks down the process of design and planning behind his file storage system.

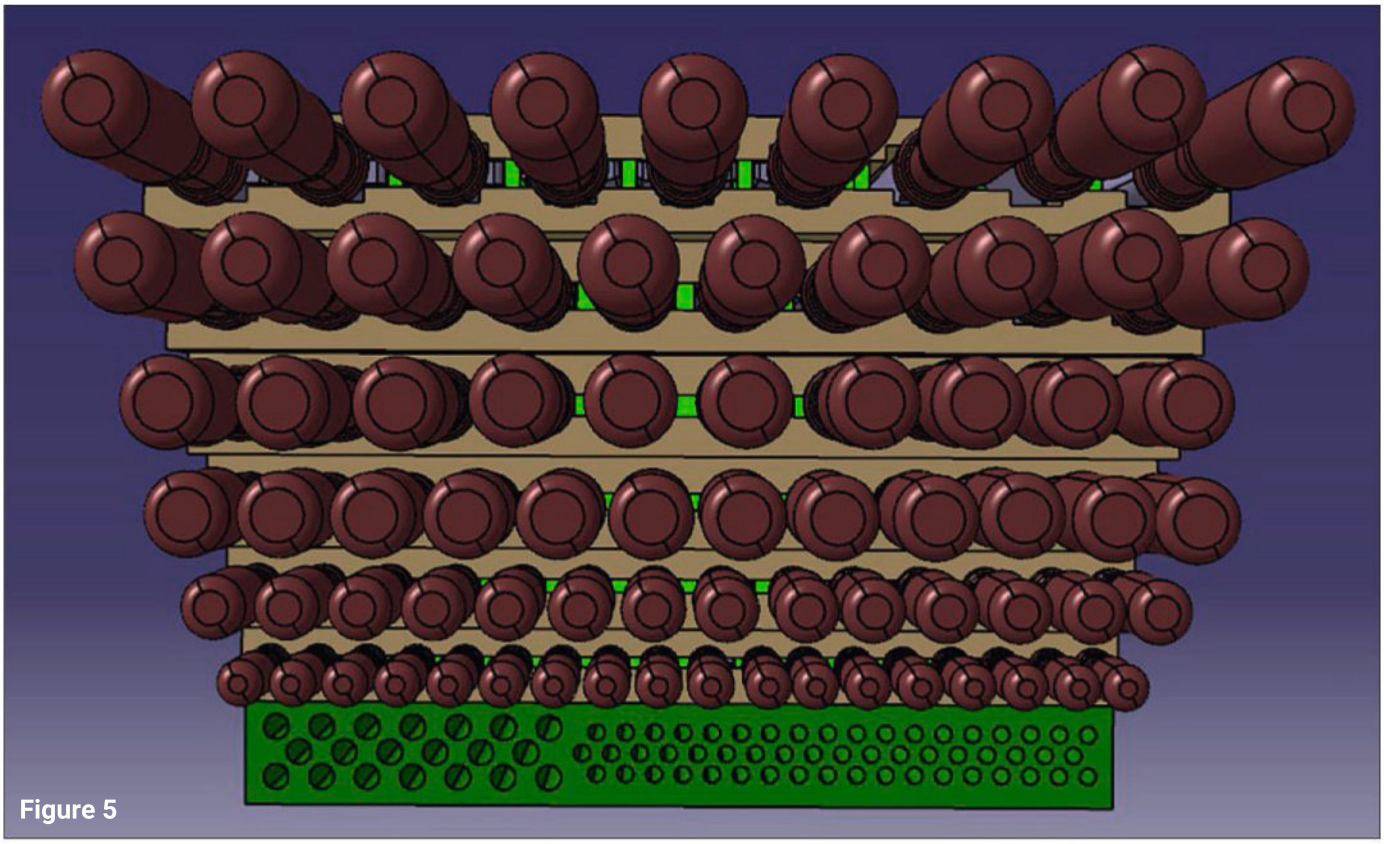


Figure 5

Liberating The Hoard

I now had to decide what materials to use from my collection of "hoarded items" that I mentioned in the first words of this article. I'd already concluded that it had to be made from wood and I had accumulated a lot of it over the years. I tend to collect hardwood, rarely saving softwood unless it's a dense, straight grained specimen. For instance, many years ago I obtained some nice pieces of mahogany from a timber merchant that was selling up and closing, which I'm still slowly using up. Other woods have been salvaged from unwanted items of furniture. Oak can be found in discarded solid-wood kitchen unit doors and I've dismantled many of them to accumulate quite a lot of that. Oak is a marvellous material to work. When its properly seasoned, which the doors obviously are, it can be sliced thinly which is ideal for making small trays and boxes for storing things in drawers and cupboards or even small complete drawers. Corrosion is supposed to be a disadvantage when storing metal things in oak boxes, caused by the release of tannin from the wood, but I haven't encountered any problems with the items stored therein. I also had some nice lengths of hardwood which I salvaged from a large garden parasol which we'd had for quite a few years before the mechanism broke. Finally, I also have a lot of plywood offcuts in varying thicknesses left over from making workshop cupboards and my benches. I like to keep those to use as sacrificial backing when machining thin plate and other pieces of flat stock which can be screwed to the plywood.

With the material choices made, some further packaging studies prompted me to design each step block as two sheets of 18mm-nominal-thickness plywood, spaced apart with thin oak strips to define each flat file section slot. The packaging exercise revealed that using the 18mm ply provided sufficient spacing to allow the file handle of each file to be gripped whilst inserting and withdrawing. The files are densely packed but still conveniently accessible without distorting one's grip to withdraw one of them. **Figure 5** shows the completed package.

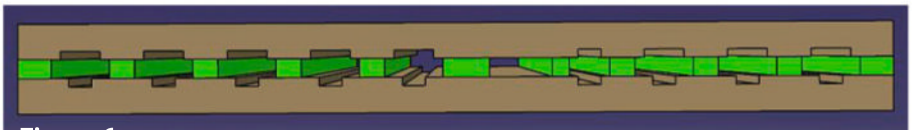


Figure 6

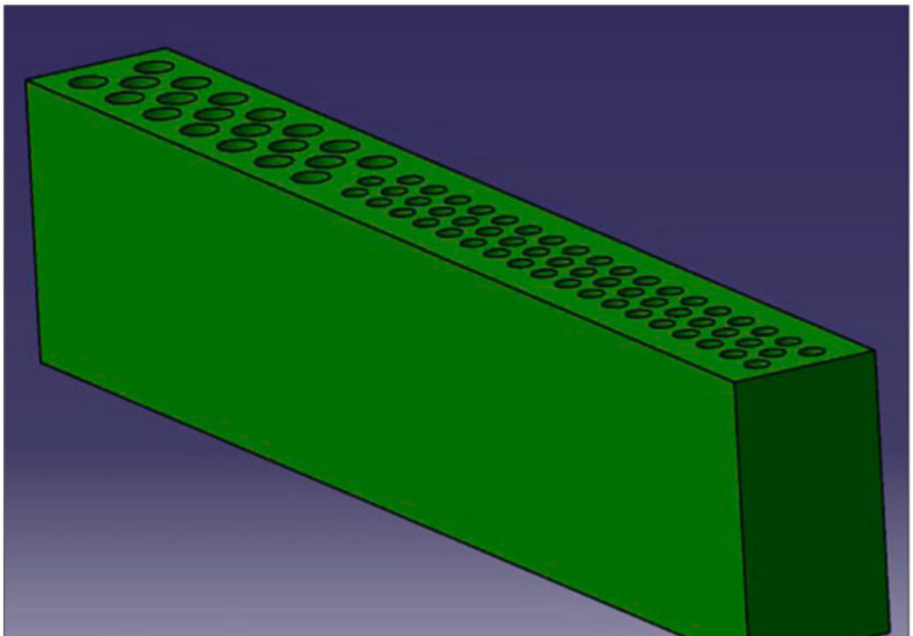


Figure 7

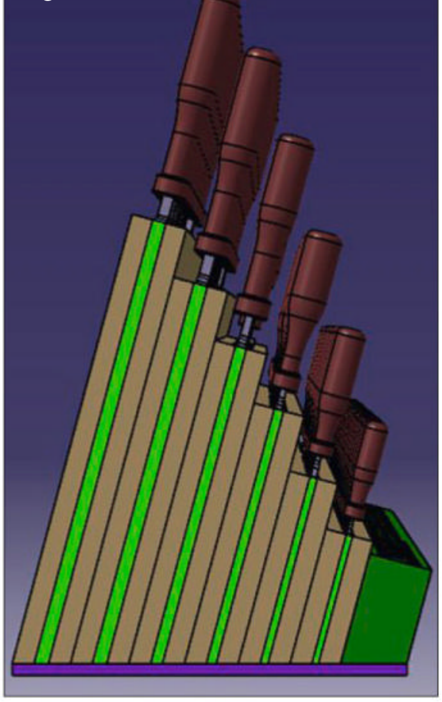


Figure 8

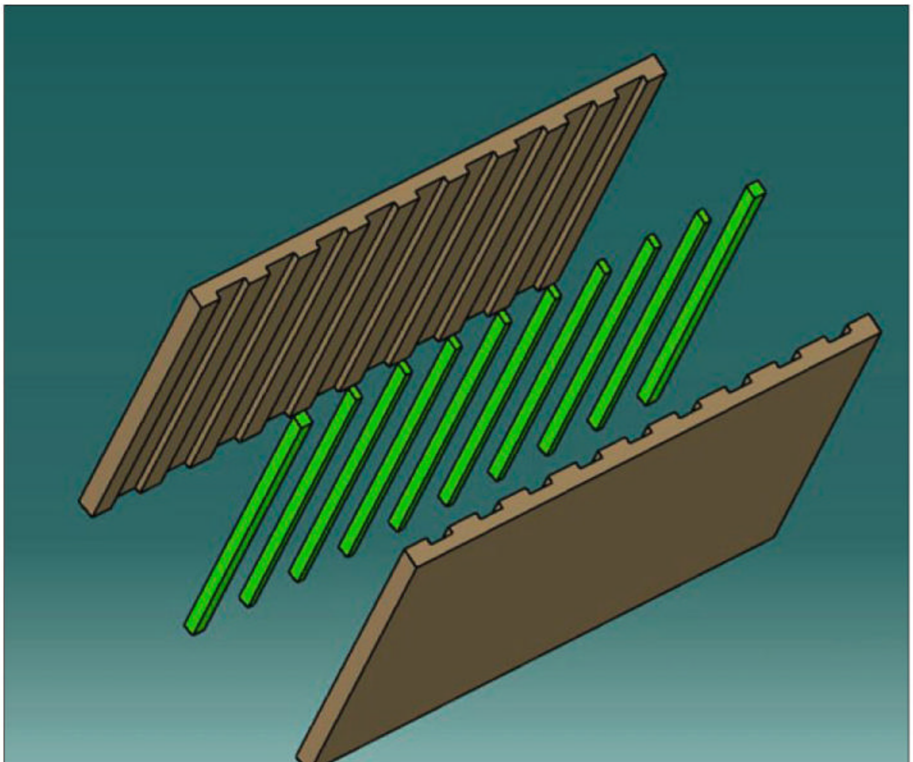


Figure 9

Finessing The Design and Construction Principles

Once I had that principal established it was straightforward to decide the width and depth of the secondary slot which would allow square, round and triangular files to be inserted. **Figure 6** Illustrates this.

Now I was set to go ahead and design the whole package. For the riffler and needle files I had concluded it would be possible to simply drill holes to set depth in a suitably sized block to insert the file into. Considering the ergonomics once more I worked out what the spacing would need to be arrive at this layout. The larger holes are for rifflers whilst the smaller diameter holes suit needle files.

I developed the idea to the stage where I had the arrangement shown in **fig. 7.**

I was also able to angle the entire block forwards by 15 degrees, enabling the contents of the slots to be observed without craning my neck to see it, meaning that I could site it at the rear of the bench so as not to obstruct the front of it, **fig. 8.**

Each step assembly consists of two pieces of 18mm nominal thickness plywood spaced apart by strips of hardwood, each lightly thicker than the thickness of the flat file that the step is designed to accommodate. The width of each hardwood strip is calculated to space the files apart equally and the end strips are sufficiently wide enough to balance the distribution of the files across the block length. Each step is constructed thus, **fig.9.** Every slot will take a flat file, **fig. 10.**

The second slot machined into the boards allows the insertion of square, triangular and round files, **fig. 11.** The construction of the entire block is made

Figure 10

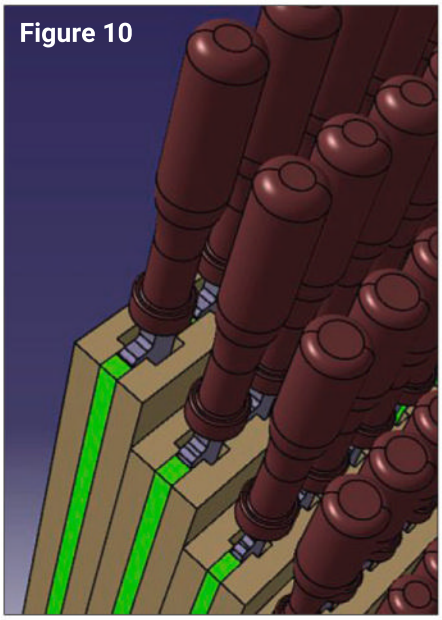


Figure 12

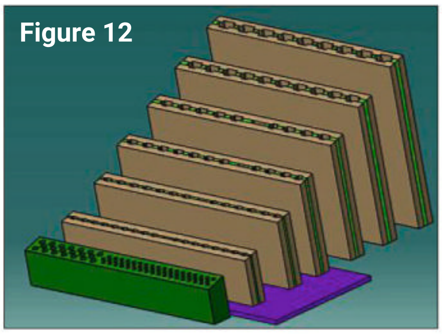


Figure 13

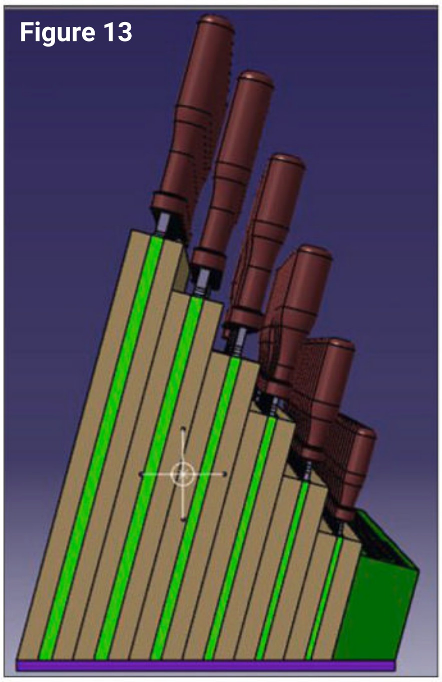
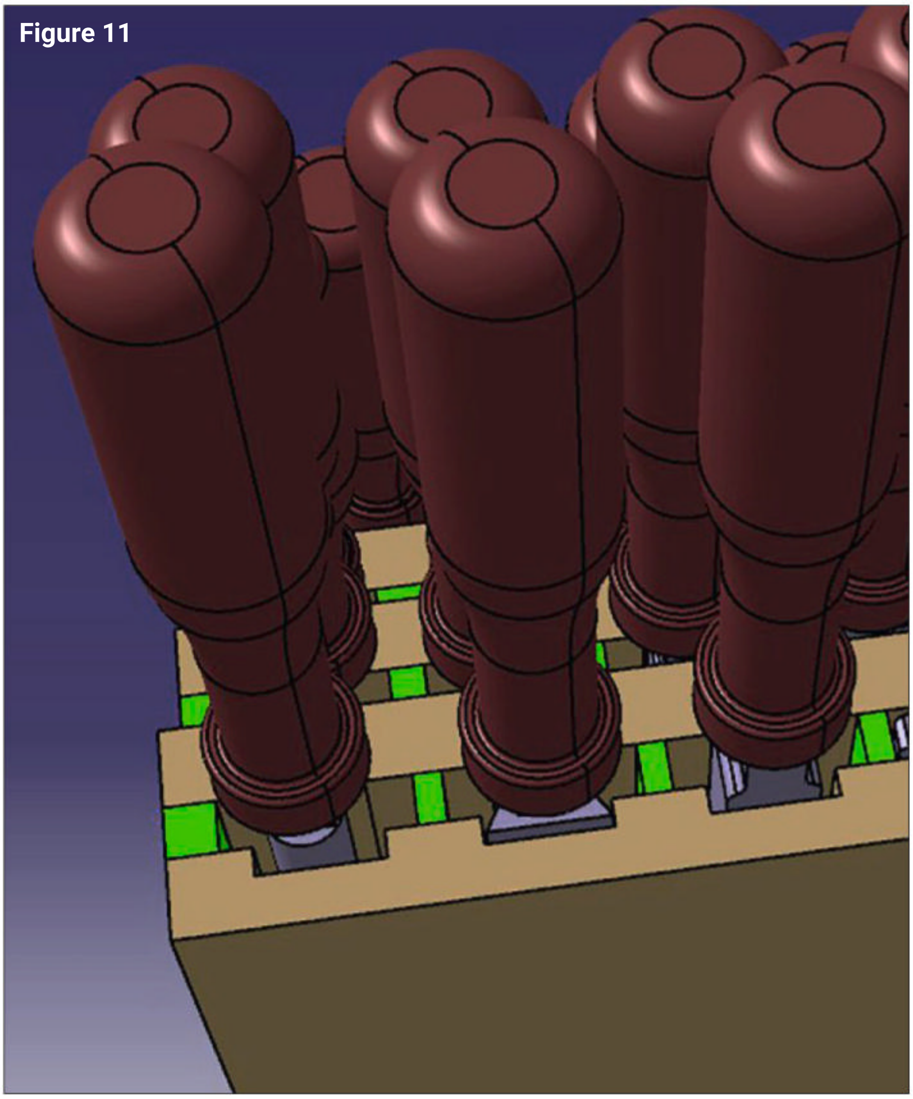


Figure 11



by laminating successive steps together as in **fig. 12**.

The base will be screwed on. I wanted it to be removable to enable metal filings, which stick to the files and fall off it after insertion into the block, to be able to be ejected before they have built up excessively in the base of the slot. I also intended to obtain and screw on three or four durable plastic feet so that it wouldn't rock when placed on the bench top. I didn't bother modelling those.

Will It Be Stable?

It was interesting to analyse the mass of the various objects from the properties assigned to each part. The files weigh 22kg according to the CAD analysis program and the block 13.6kg. That's another benefit of solid modelling in CAD.

The CAD analysis program also allowed me to ensure that the location of the centre of gravity wasn't going to cause stability problems when fully loaded with files. It's located approximately 10mm away from the block centre along its length so I was confident that it would be stable when sitting on the bench top. Its location in two directions is clearly shown in **fig. 13.**

Decision Time

With all that proven on the CAD screen it was decision time. The block occupies a surface area of 420mm x 316mm, so it met my bench top space usage requirements. I could fit every file in my collection into it with space to add a few others should I purchase any in the future. I could also manufacture it using the tools and machinery that I own, using materials from my stock to build it. I had already decided how I was going to join it all together since the tight packaging clearly didn't leave sufficient room for screws, nails, dowels etc. The riffler and needle file block is produced from three pieces of 18mm nominal thickness plywood glued together using Evostick waterproof woodworking adhesive and I saw no reason why I couldn't bond the rest of it together in the same way.

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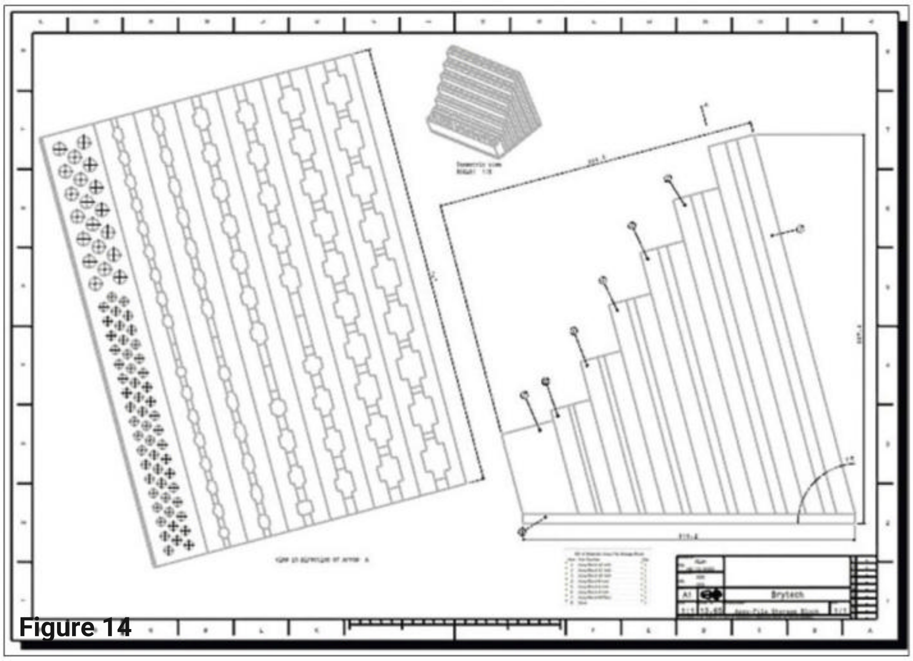


Figure 14

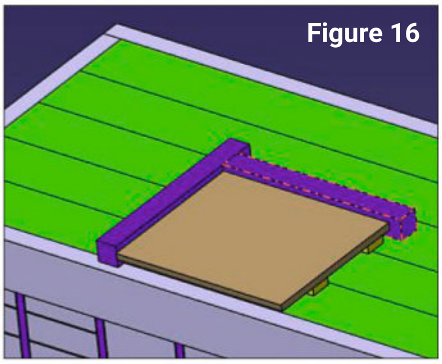


Figure 16

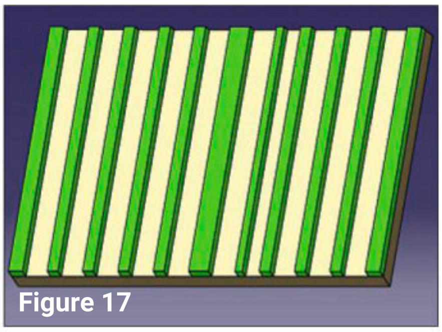


Figure 17

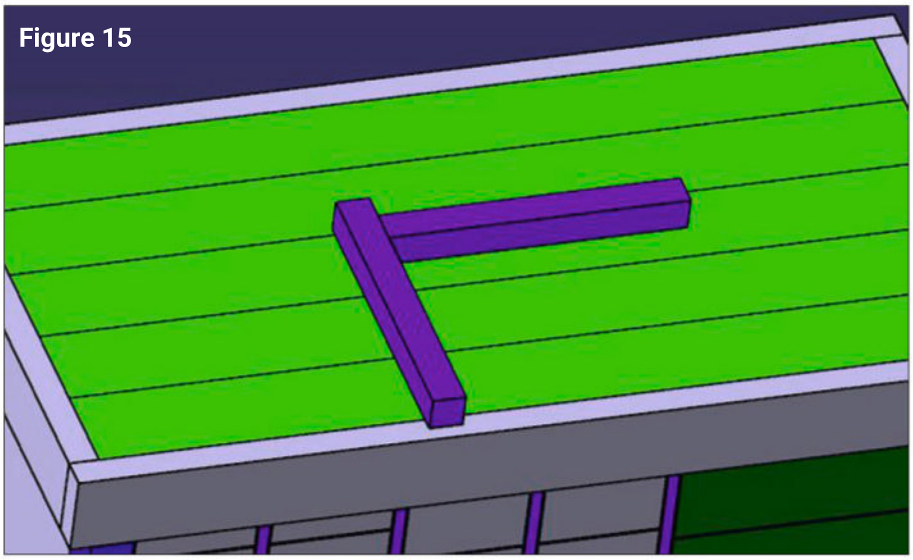


Figure 15

With that decision made I produced a set of drawings which broke each step block into a sub-assembly. The General Assembly Drawing is **fig. 14.**

Preparing For Manufacture

Each step sub-assembly was drawn on a separate sheet fully dimensioned. Using CAD makes it easy to produce drawings which take very little additional time to do. Most systems will even produce dimensions automatically too. I never use that facility though, preferring to select which features to dimension.

I now had to decide how to make it since I wanted to produce something which at least looked like a professional job when given a cursory glance. I don't claim to be a precision woodworker, but I do try to achieve a reasonable standard in what I make so I had to think it through properly.

Manufacturing the Block

When it comes to laminating plywood the best way to achieve something that looks like it's a solid object is to make it oversize, glue it together and cut it to size afterwards. I've already mentioned my Makita 2704N-260mm table saw which is capable of a 93mm depth of cut so I decided to fabricate each step assembly separately making it oversize in both length and height. I would therefore glue up the whole thing then reduce it in length by cutting up the step assembly. Then I would glue two step blocks together and cut those to the finished length of 420mm. At that point I would also cut the 15-degree angle on the bottom. The angled depth of cut on my table saw was sufficient to produce a clean angled cut on all steps apart from the glued together 12-inch and 14-inch blocks but I overcame that problem. I'll go further into the stages necessary in the following text so stick with me please. If you've got this far then I'm continuing to hold your interest. Lastly at this point I'll also explain that I used the table saw to produce the second slot in each file location because I reasoned that it would be quicker and easier to set up than routing or milling the slots on the Bridgeport. I did use the Bridgeport and its DRO to position and drill all the holes for the needle and riffler files. It's great for woodwork but that's another story.

I decided to cut each plywood sheet for the blocks 430mm long and 10mm wider than each step's tallest dimension. The top edge of every sheet and the outside and inside faces were marked on each. All were cut square on the table saw using a fine-tooth blade. I used a cross-cut sled for cutting the edges square so I could cut the two sheets of each step together.

A piece of hardwood of sufficient size for the number of strips in each step was cut to thickness then the strips were cut to width from it, remembering that not all are the same width. The end strips were each cut to a width 5mm greater than required to account for cutting the

boards 10mm over length, whilst there are also different widths as dimensioned where the knife file slot is situated. The strips were each trimmed to a length 5mm shorter than the width of the board. One of the boards for each step was then marked up on the inside face for the locations of each strip, keeping each strip location line square to the top edge and remembering to allow for the 10mm over-length.

Assembling The Steps First Stage

To assemble the first step, I arranged two 75mm high fences at 90 degrees to each other on the bench, **fig. 15.** I then pushed a corner of the marked-up board into contact with both fences, **fig. 16**.

Each strip then had glue applied to it and each was placed in the correct location as it was marked out on the board with the top end of the strip and the long face of the end strip contacting the fence. If pressed hard into place, I found that Evostick woodwork adhesive would grip the parts together, although initially one would float against the other until surplus glue was excluded. That was the main reason why the whole step wasn't assembled at one time because the danger of strips floating away from their locations was too great. However, since it was impossible to apply clamps to every strip, I weighted the whole thing down when I was certain that strips wouldn't move away from their marked stations. They were left to dry overnight.

Once dried I was able to trim the top edge of the board by the minimum amount possible to cut the strips and board flush with each other by using the table-saw fence against the bottom edge of the board. This was why the strips were cut 5mm shorter than the board width. This produced the arrangement in **fig. 17**.

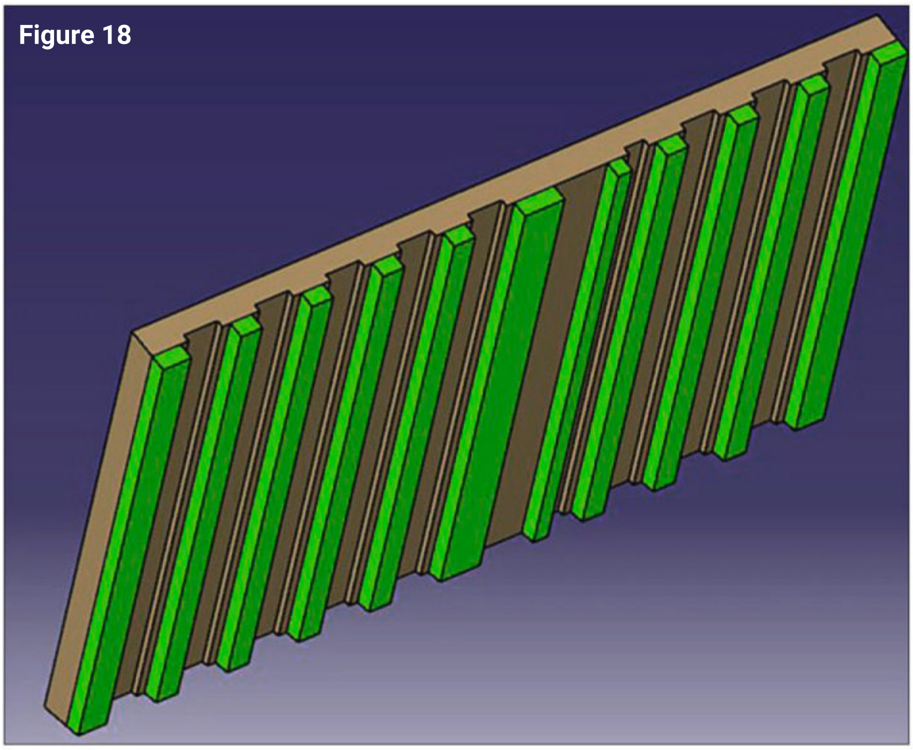


Figure 18

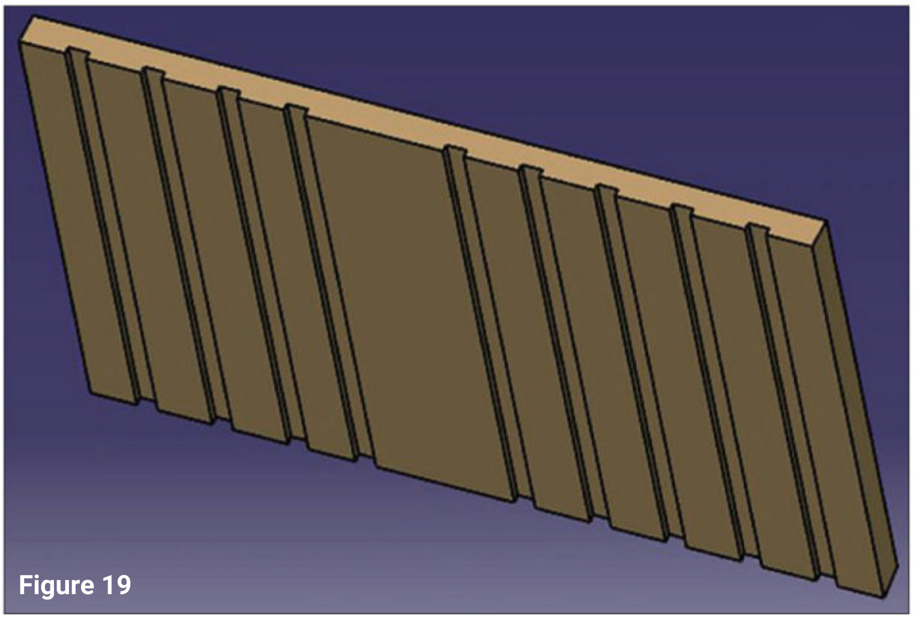


Figure 19

Secondary Operations

The next day the boards were clamped together in a vice with the top faces and end faces coplanar to their neighbour, inside face to inside face, and the locations of the second slots were marked across on the top edges. I had decided to use the cross-cut sled on the table-saw with the fine-tooth blade fitted to produce the slots on each inside face by making multiple cuts close together. I used clamped-on stop blocks on the sled, so the start and end cut positions of each slot were clearly defined, resetting the stops after each slot was cut. Although it was somewhat tedious to do it that way, the end-result was good. I cut each slot then moved the stop blocks to allow the next slot to be cut. OK, I could have done it on the Bridgeport or by routing it against a clamped-on fence, but I chose that method as the quickest way to do it. I don't have a router table though. Perhaps if I did, it may well have been the best method.

Because the glued-on strips required the saw blade to be set higher for the board with the glued-on strips, it meant that I had to do one board then reset the cut depth and repeat the operation for the other board. I also used this opportunity to true up the edges of several of the glued-on strips which had become slightly misaligned before the glue dried. Overall, I think that it worked out well. **Figure 18** shows the result. For the other board, I simply set the saw blade a few millimetres lower and repeated the process to produce, **fig 19**.

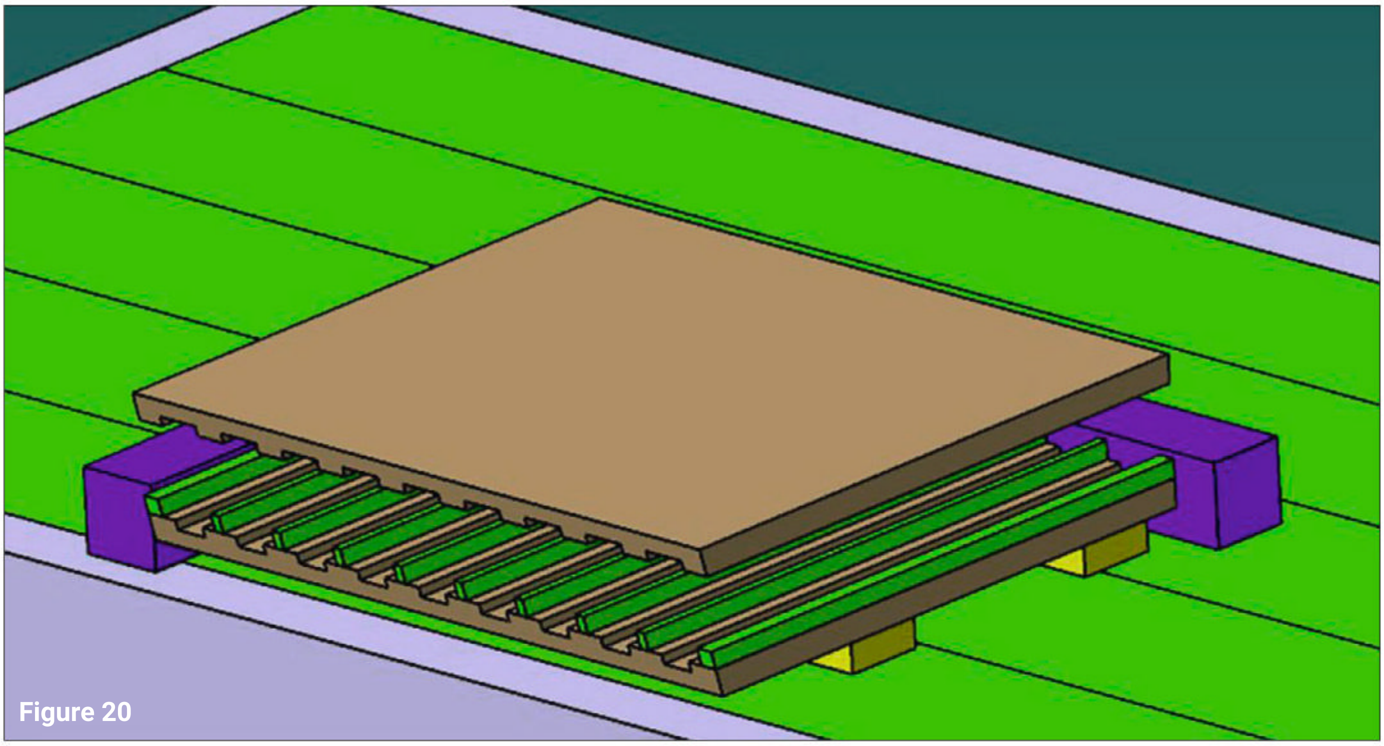


Figure 20

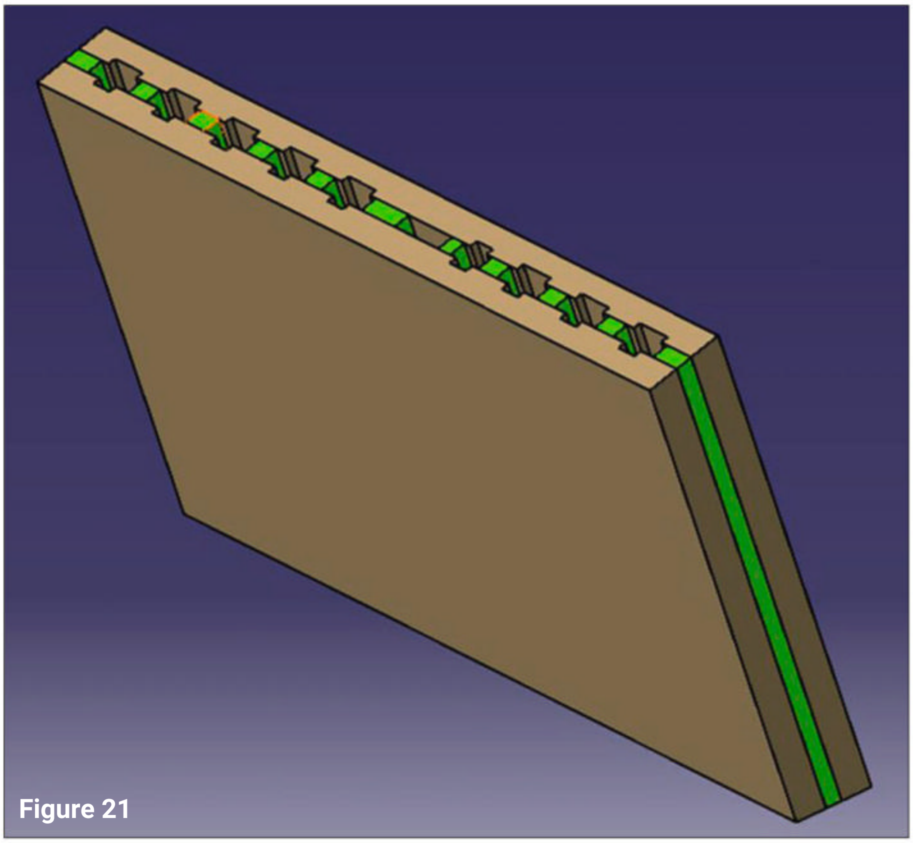


Figure 21

Assembling The Steps

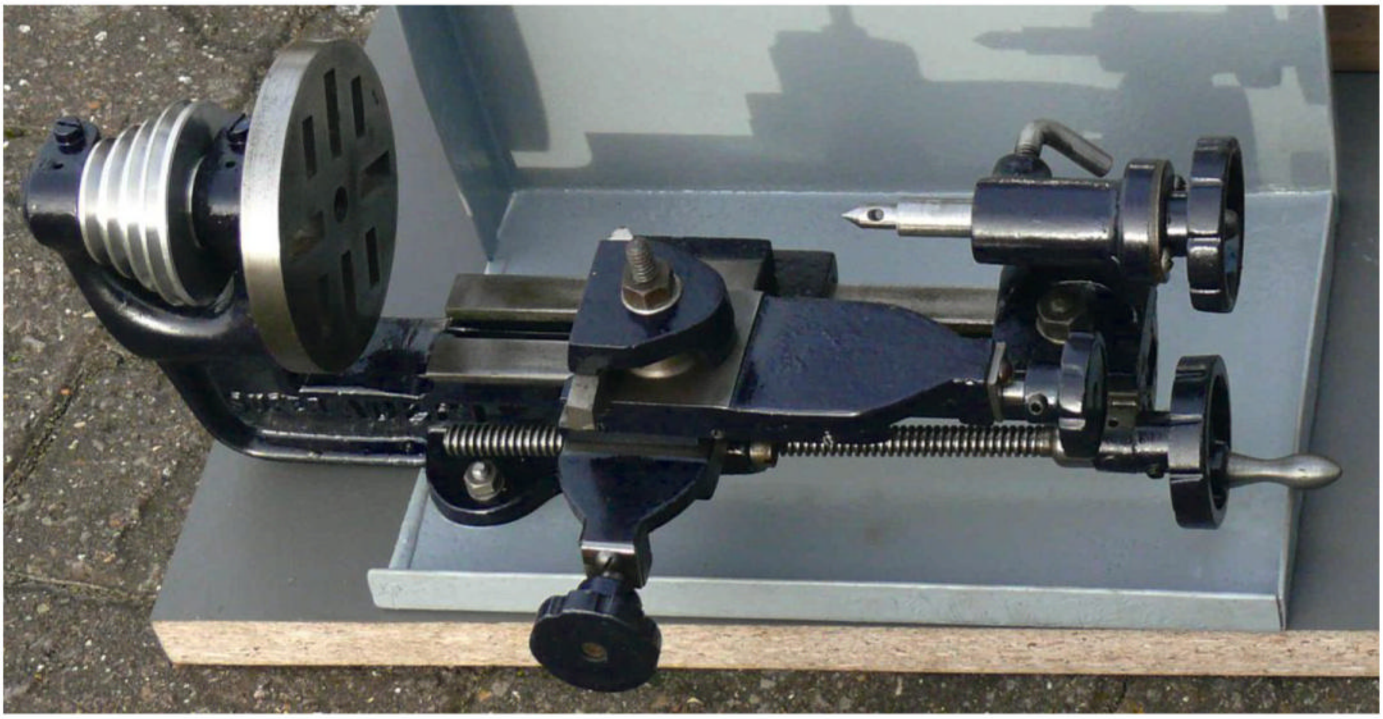
Now it was time to create a complete step sub-assembly by gluing on the second sheet. To align it for assembly, I again used the fences fixed to the bench that I had used previously. It was then a matter of spreading glue carefully onto every mating surface of the strips on the sheet and strip sub-assembly, before laying it flat on to four plywood offcuts of equal height which were thick enough to allow me to insert clamps between the sheet and the bench.

Figure 20 shows it positioned with the second sheet about to be placed on to it. Then, the top edge and one side edge were pressed tightly into the corner thus created by the fences. That enabled the second sheet to be aligned reasonably precisely by also pressing it tightly into the corner as it was lowered into position. Then I carefully applied pressure using clamps to ensure that both parts were in contact with each other. I had to be careful that the parts didn't float away from each other on the glue, so I had to gradually tighten the clamps whilst tapping the edges of the sheets with a plastic hammer to keep them in contact with the fences. When I was certain that I had both parts in alignment and clamped firmly I added as many clamps as I could to ensure that full contact was maintained whilst the glue dried. I repeated the sequence of operations for all six steps and on the largest steps I used up to 12 clamps of varying sizes together with my 6-inch bench vice. It was fiddly but successful. The first completed step is shown in **fig. 21**.

Flushed with success I carefully repeated the previous processes for the remaining steps. Each completed step was left overnight in the clamps which were removed the next day. Alignment was rarely perfect although the top edges were often in close alignment. Anyway, it was straightforward to work around that problem. ∎

Reviving A Super Adept Lathe

Several years ago, at a car boot sale, Howard Lewis bought a Super Adept lathe, that he recently restored.



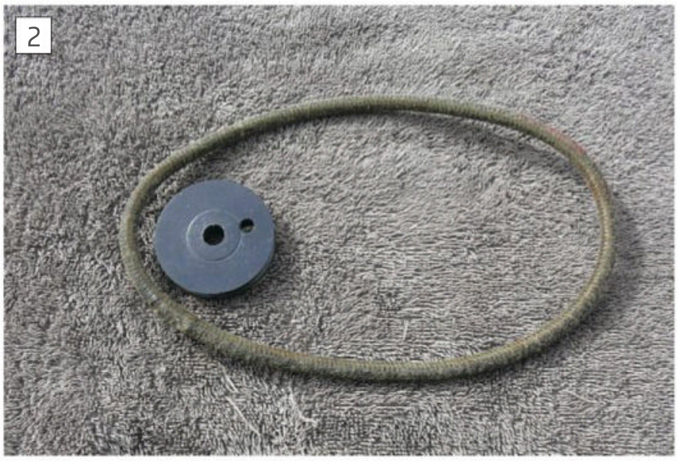
The Super Adept Lathe.

In 1931, Fred W. Portass introduced the *Adept* lathe. This new machine was tiny, barely a foot long, and lacking a moveable saddle. It was about as basic a machine as you could get. But it was a working lathe, and despite its tiny mild-steel spindle running in plain cast-iron it proved surprisingly popular. The cost was low - 12/9d or about 64 pence in 1936. Not a casual purchase then, but within the reach of many ordinary people. In response to demand the *Super Adept* was released, benefiting from a proper moveable saddle operated by a leadscrew. The main limitation of the lathe was the spindle with a custom taper far smaller than MT0.

Accessories for the lathe.

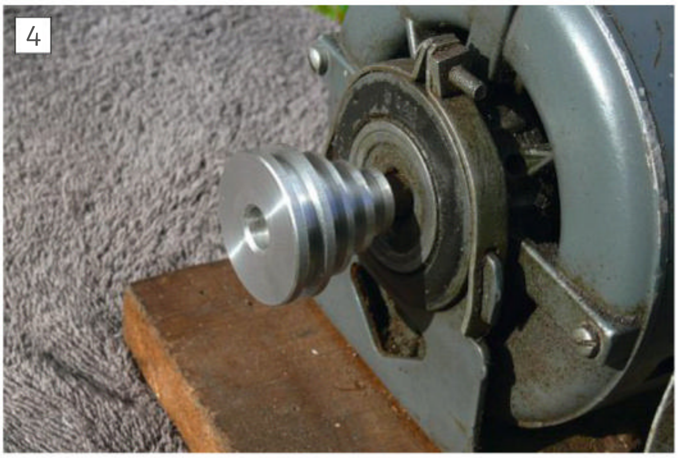
The Super Adept I bought was mounted on a baseboard, complete with a motor and a wooden box containing a faceplate, catchplate, driving dog, two dead centres, a chuck key and a couple of dead centres, plus a couple of tool bits, and some odd setscrews. The Adept branded four jaw chuck even came in the original box, **photo 1.**

›

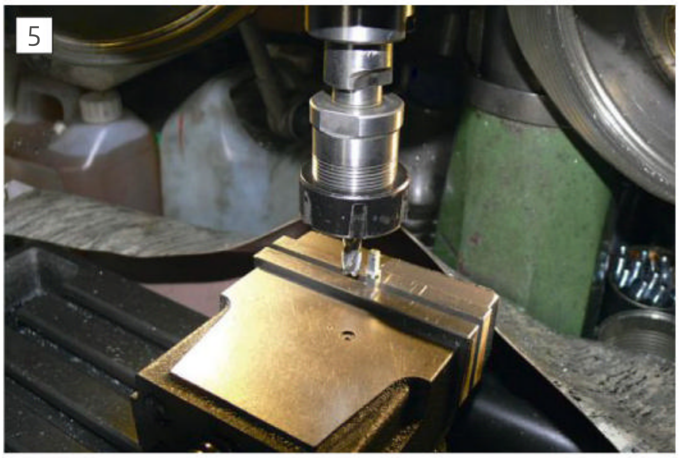


Original pulley and belt.

New headstock pulley and thrust washer.



New motor pulley.



Milling new adaptor for chuck key.

Once at home, the purchase was examined in greater detail. Everything was grubby and dusty, and the wiring was covered by lots of plastic insulation tape. Firstly, the lathe was removed from the baseboard, stripped and given a preliminary clean. After this, the machined surfaces were masked off. Having smuggled it into work; at lunchtime, the pieces were bead blasted until all the visible metal was clean.

Once at home again, the parts were painted with what seemed to be the shade of blue, closest to the original, before being reassembled. The mandrel carried a single groove pulley, and a heavy circular section cord belt, **photo 2.** This decided me, that at, some future date, i would fit pulleys to give the lathe a multispeed capability.

With that, the project went into hibernation, until the subject of the super adept came up on the ME/MEW forum.

Now, several years on from the initial purchase, I had to remember just where the baseboard and motor had been stored. After half a day searching workshop and garage, the bits were found at the bottom of a pile in a corner.

Mechanical work

The first resolve was to make new multi-groove pulleys, for 3mm polyurethane belting. As measurements of the mandrel and the space for the new pulley in the headstock were taken, it became obvious that the thrust washer behind the mandrel flange was steel. Replacing this entailed turning up a brass washer,1/16" thick. (phosphor bronze would have been ideal, but none remotely near right size was to hand, so brass was the best that could be managed).

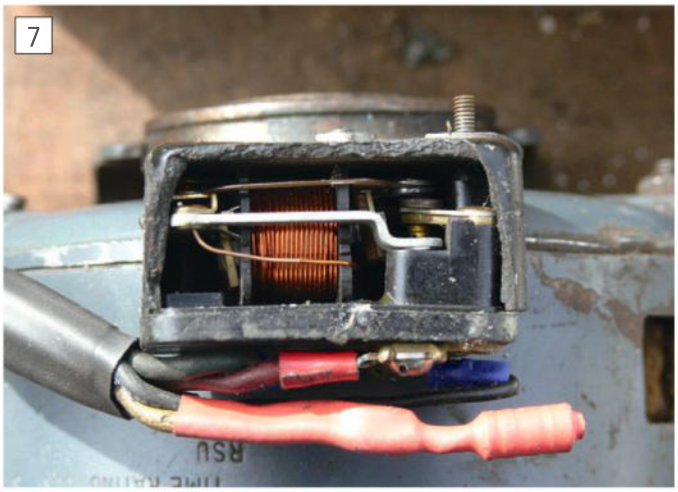
To turn belt grooves required a tool of the correct (arbitrarily chosen) form. This meant grinding a tool to produce a groove with a 30-degree angle. Given the availability of the Worden cutter grinder, this was relatively easy.

The first attempt at making a multi-groove pulley was a total disaster, both in choice of material and method. With 20/20 hindsight, it was silly: to use cast aluminium; and to turn the blank to size before machining any of the grooves. Turning a vee groove, in cast aluminium, with only a 0.40" land on one side, was asking for trouble, and not surprising that the metal fractured.

The second attempt was made using aluminium bar, starting at 2" diameter, and turning down to the next size, once the groove had been formed. (a parting tool was used to remove the metal central to the groove before using the form tool) this went well, working from the outer face as datum, until I lost track of the ordinate for the next groove position.

By now, I was running short of dog ends of aluminium long enough to chuck the embryo pulley, so the technique was then to face the stock to length before drilling and reaming to 3/8" diameter, ready to match a mandrel which was about to be turned up. (in the hope of obtaining greater accuracy, I used a floating reamer holder that I had made up, for use in the tailstock).

Chuck key with old and new drives.



Broken relay box with new terminals.

An arbor was then turned to 0.375" diameter, with a 3/8unf male thread on the outer end, to allow the aluminium blank to be gripped between two plain washers, ready for groove forming.

This time, a four-groove pulley resulted, with the grooves more or less in the intended positions, **photo 3.**

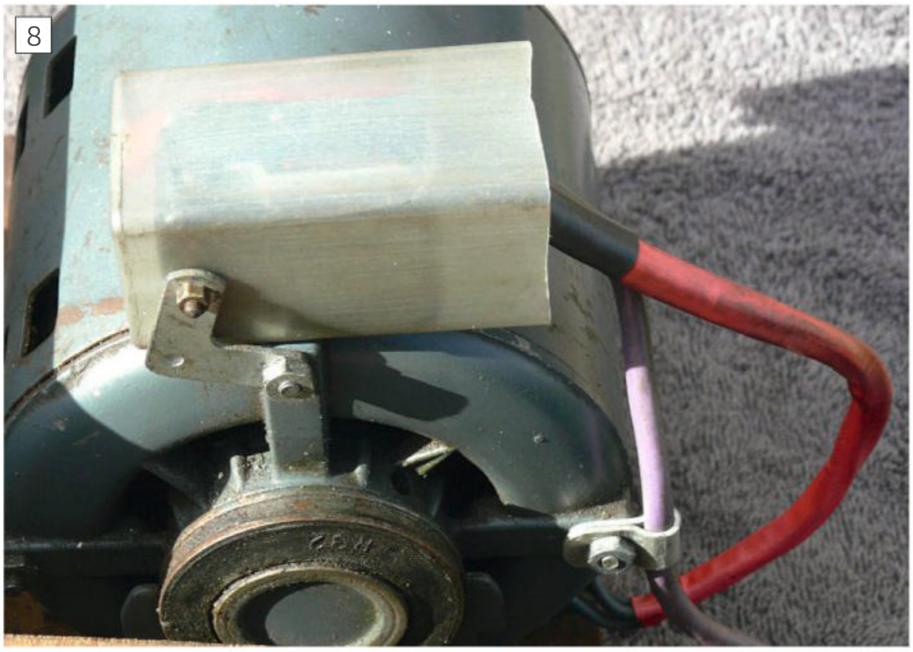
Then, having removed the coarse groove pulley from the motor, it was time to measure the shaft diameter. Happily this was also 3/8", so the procedure for the mandrel pulley could be repeated to make the motor pulley, **photo 4.**

The intent was that the smallest diameter would mate, via the belt, with the largest diameter on the other pulley. Also, the diameters, and resulting ratios, were chosen to allay my fears about running a steel shaft and high speed in cast iron. A quick calculation showed that no change in belt tension should take place as ratios were changed. The final operation on each pulley was to set it in the mill/drill and align so that an M3 tapping could be made in a groove, for a grubscrew to secure each pulley to its shaft.

The chuck key had once been the wrench for a cheap tap and die set but held a twisted square piece of metal that was so soft that it could be straightened with a pair of pliers. A replacement was milled from a piece of 1/4inch silver steel, **photos 5** and **6.**

Electrical work

Once the mechanical work was done, the electrics came under scrutiny. After the plastic insulation tape was removed, it was obvious that this was a good course of action.



Relay box with new cover.

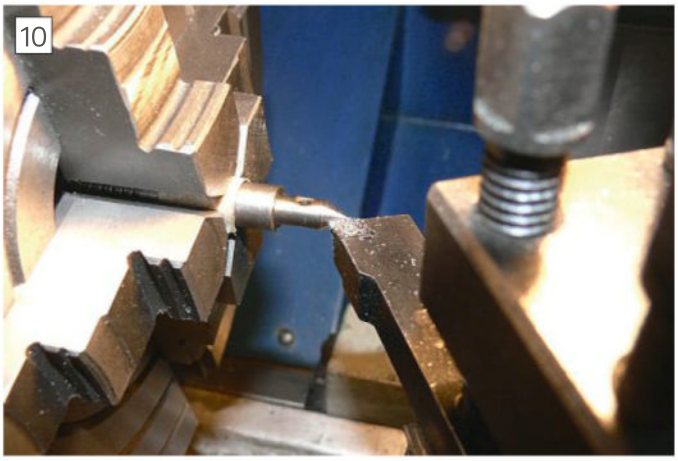
What I thought was a capacitor for the motor, was, in fact, a relay; but with the side of the Bakelite box broken away to reveal the internals. Where wires were fixed to the relay terminals, or joined together, they had merely been twisted together and taped up! The connections to the relay were fitted with crimp on ring type terminals, **photo 7.**

The other connections, instead of being merely twisted together, were soldered and covered with heat shrink sleeving. To protect the wires leading to the motor, they were threaded through heat shrink sleeving. Because there was a mains connection to one of the wires leading to the motor, the mains lead was also held to the motor wiring with heat shrink sleeving.

The problem was how to make safe the relay box and its terminals. The solution came in the form of a plastic box which had once contained a 2MT stub arbor. This was just the right size to slide fit over the relay and its wires, and to cover the mains/motor wire connection in its heat shrink sleeve. A small hole allowed access to the 6BA securing bolt, and when cut to length, there was no access to live terminals, **photo 8.** The mains feed wire was clamped to the motor body, to act as strain relief, with a simple aluminium clip.

The rear of the motor lacked the clamp securing the resilient mounting to the motor cradle, so, using the front-end parts as pattern, a similar arrangement was made up. This turned out to be an ›

The new motor clamp.



Trimming the dead centres.

expensive operation, **photo 9**, as I was ham fisted enough to break a 4mm endmill whilst machining the slots.

The dead centres were showing their age, so using the tailstock arbor, clocked to run true within 0.0005 inch in a 4 jaw chuck, the centres were cleaned up with the topslide set over by 30 degrees, **photo 10.** With hindsight, the mandrel would have been a better arbor to use. A short piece of silver steel was cut, for use as a tommy bar to remove the centres.

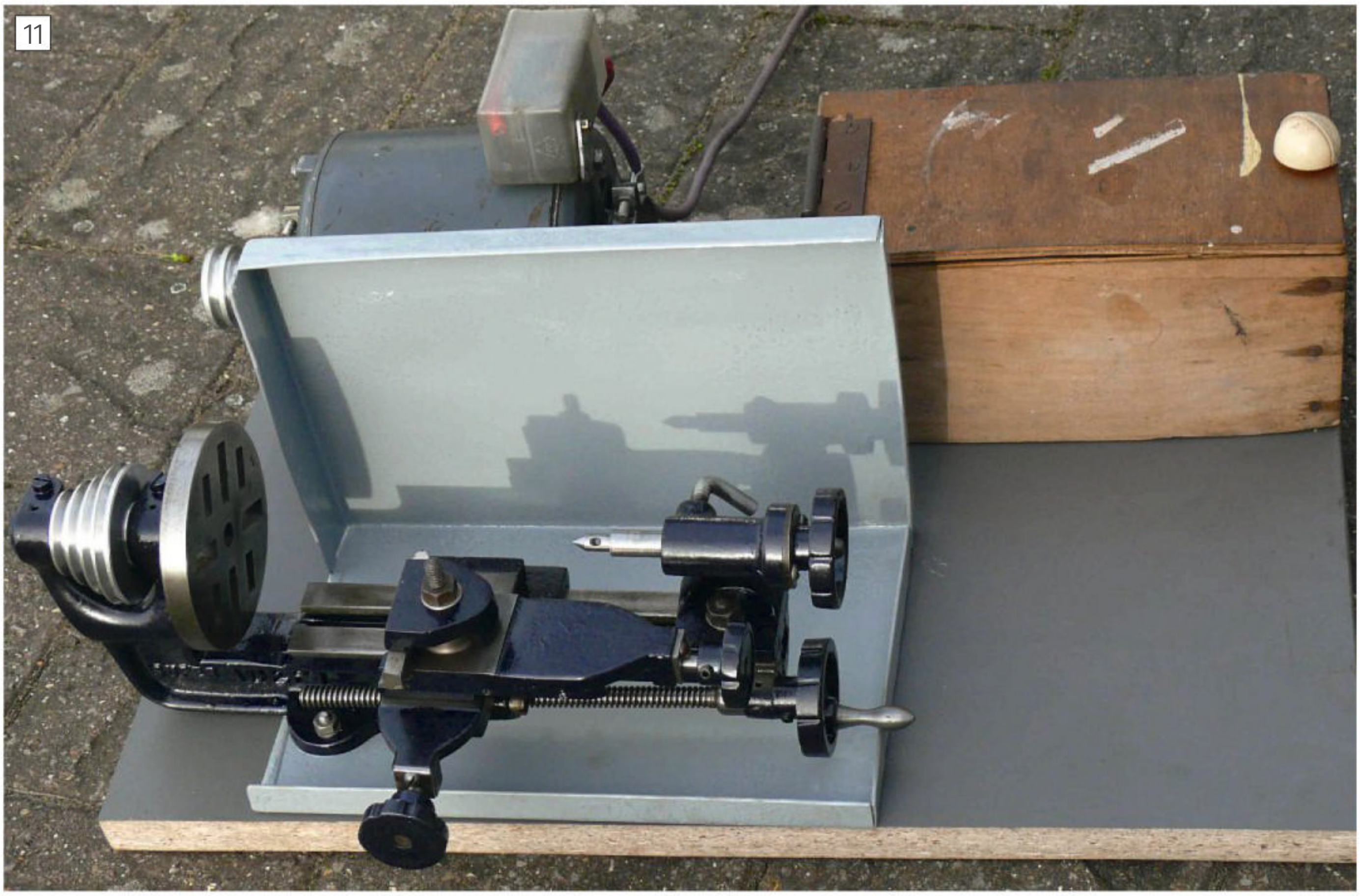
The baseboard.

This was a small piece of grubby nondescript timber, obviously awaiting replacement.

A piece of faced chipboard was cut and sanded to 12 x 18", and then drilled for the motor and lathe fixings, using the original baseboard as a template. The holes on the underside were countersunk. (on the original baseboard, the holes had not been countersunk and the screw head showed signs of wear, as a result).

The fixings were shortened, to prevent fouling the motor cradle, and new 2BA fixings used to secure the lathe. Before the lathe was fixed down, a new steel chip tray / splashback was made up, ensuring that all edges had been safe-edged; and painted. This replaced a roughly curved piece of aluminium sheet.

Other than the lack of a drive belt, the end result is shown in **photo 11**. And the handle does not foul the tray! The wooden box will eventually be superseded, another "round tuit" job!



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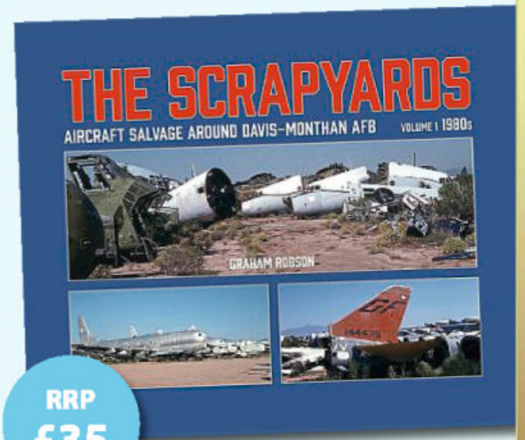

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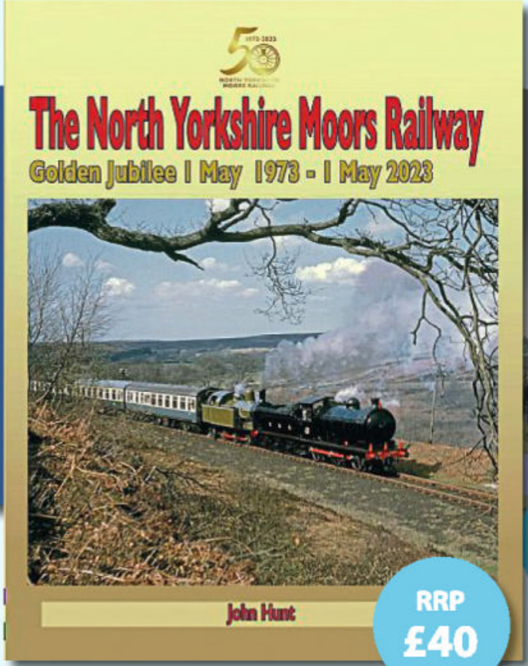

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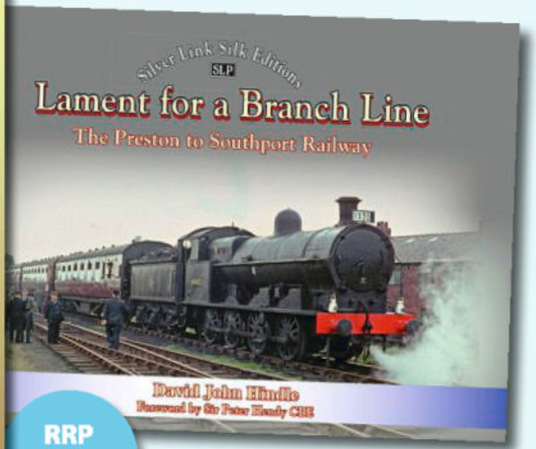

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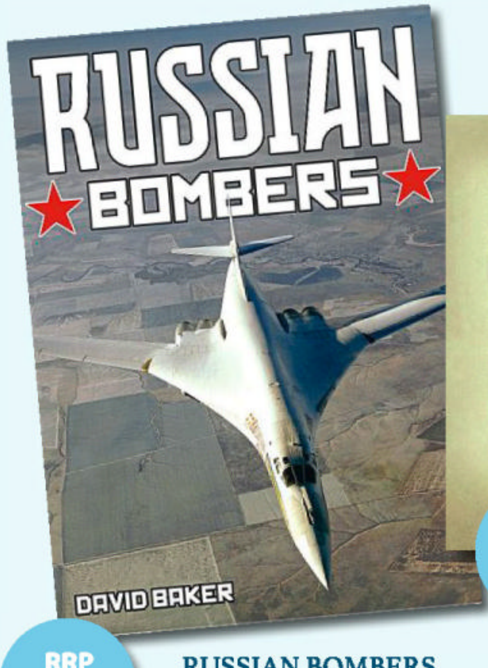

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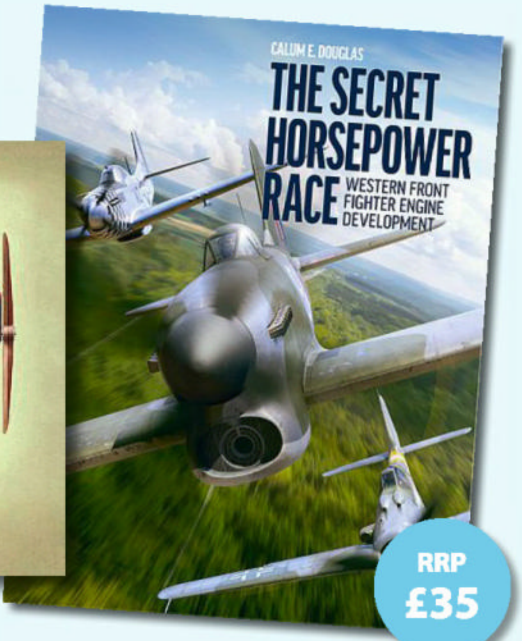

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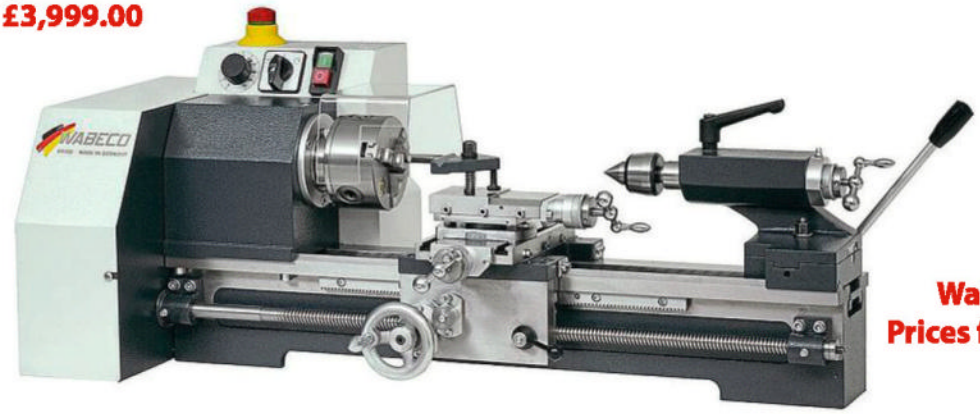

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